



Charles E. Kellogg

DOWN-UNDER JOURNAL



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1949

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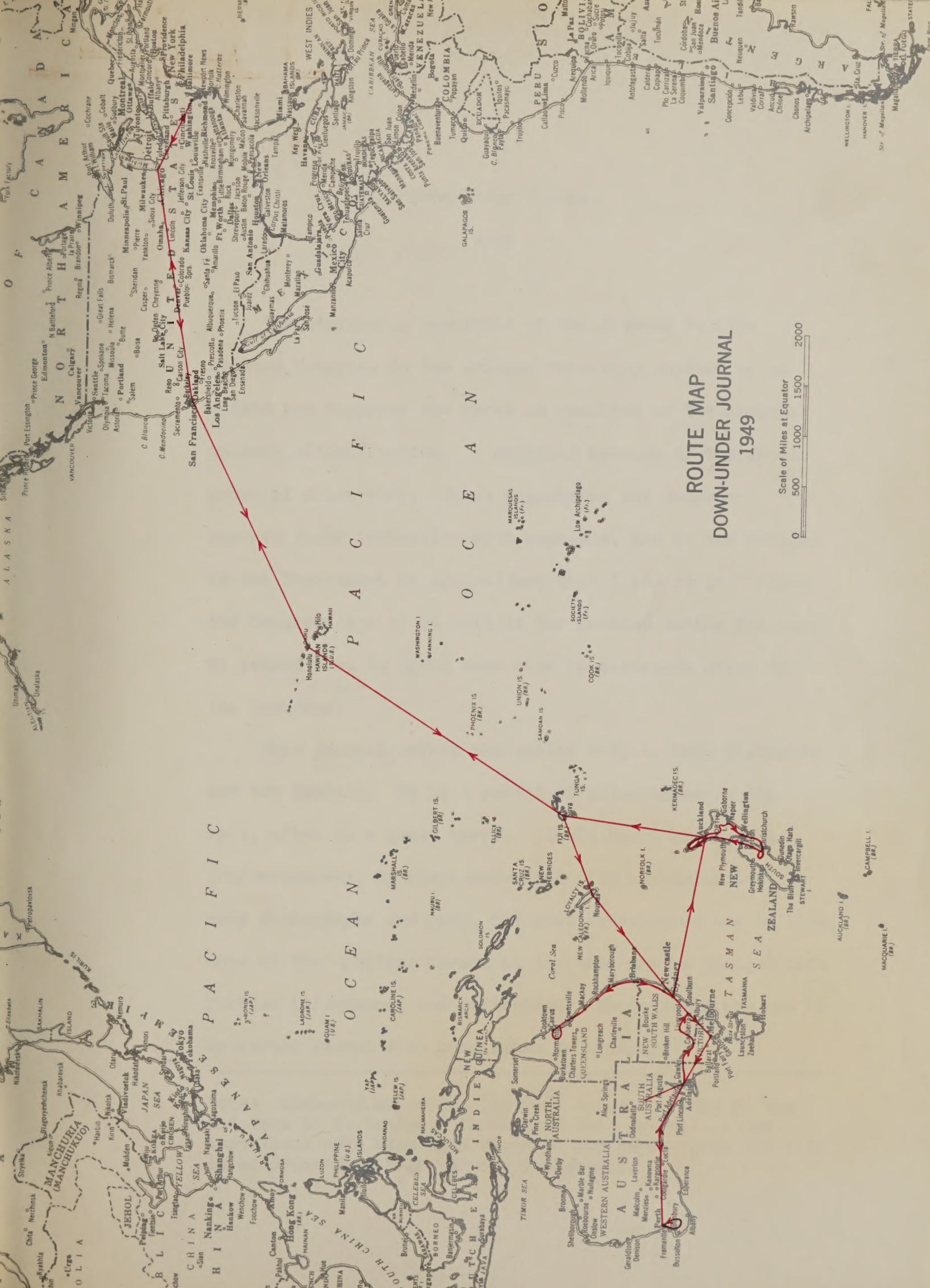
Volume II

New Zealand

Charles E. Kellogg

1949

ROUTE MAP
DOWN-UNDER JOURNAL
1949



ROUTE MAP DOWN-UNDER JOURNAL 1949

Scale of Miles at Equator
0 500 1000 1500 2000

Down-Under Journal

1949

The organizing committee of the Seventh Pacific Science Congress in New Zealand cordially invited me to attend the Congress and serve as chairman of the program on soil classification. I declined because of the great press of other work. Those organizing the Congress renewed their invitation with emphasis, and it was decided in the Department of Agriculture that I should go. Since the Congress was to be held in New Zealand during February, it seemed wise to spend some time in Australia prior to the Congress.

This journal covers the entire trip -- both Australia and New Zealand. It is a record of notes taken on the spot, often in a great hurry. Likely there are errors. (Unfortunately, my black-and-white film was defective, so many photographs are poor, but good kodachromes are on file.) Some of the opinions formed at the time may be changed with further information and reflection. These notes are not to be quoted except with permission in writing.

Note: Numbered asterisks (as 3*) refer to notes at the end from L. I. Grange. Throughout this journal, a few insertions have been made right on the page; these are also in accordance with Dr. Grange's comments.

January 31

In the plane from Sydney, I fill out four questionnaires for the officials at Auckland.

We are down in the port at Auckland about 4:00 p.m. We are met by several of our New Zealand hosts. Dr. Grange takes me to the Trans-Tasman Hotel. I sort out my clothing, send a cable to Washington, and complete arrangements to go to the north part of the North Island very early tomorrow morning! (I had hoped to catch a day's rest, but that's out.)

After dinner, I am early to bed.



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C 1453

A.P.-30 NEW ZEALAND

1,000,000
WAC 1474

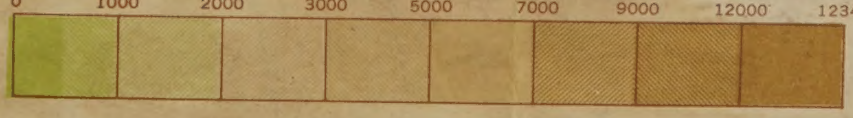
1,000,000
WAC 1552

1,000,000
WAC 1570

Scale 1:5,000,000

Elevations in Feet Above Sea Level

0 1000 2000 3000 5000 7000 9000 12000 12349

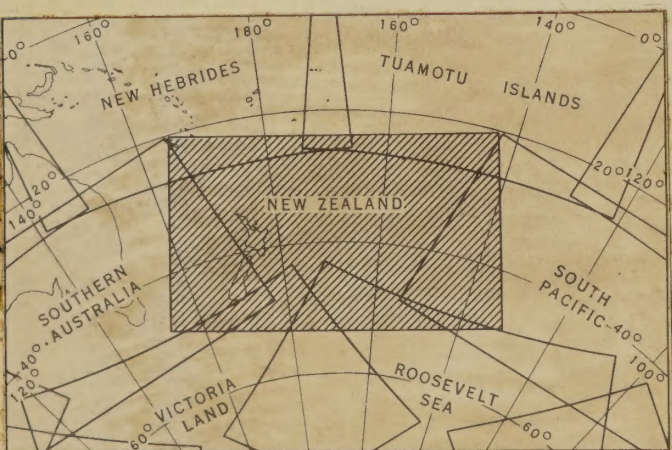


CAUTION

Contours shown on this chart should be regarded only as
form lines of probable elevations.

AP-30 New Zealand

Scale 1:5,000,000



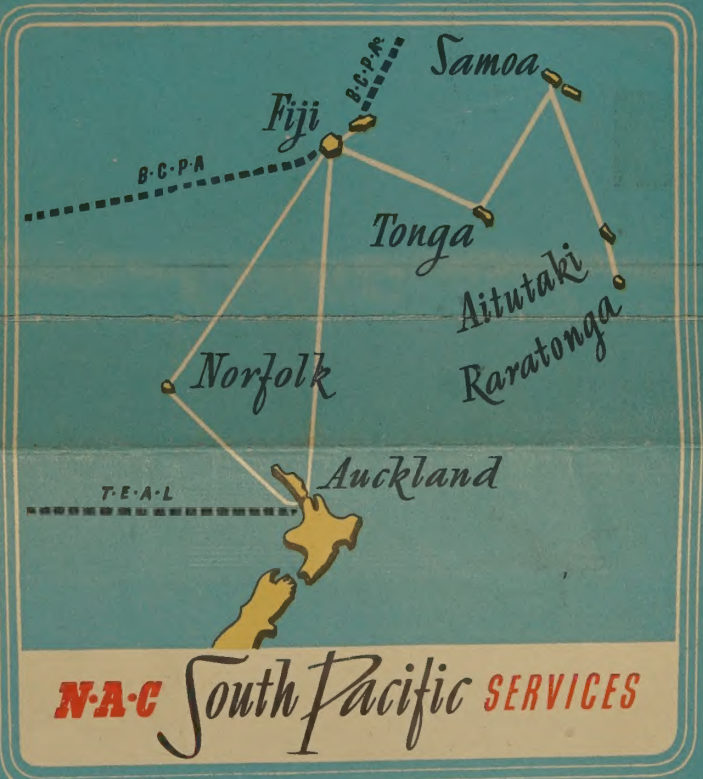


DID YOU KNOW?

1. New Zealand's climate — measured in sunshine, equals that of Italy and enjoys about 600 hours more than Great Britain each year.
2. The reach of New Zealand is from the tropics to the Antarctic—from controlled islands in the North to the Ross Dependency in the South.
3. New Zealand has 850,054 acres of scenic reserves which belong to the State and a further 3,139,729 acres of public domains and national parks.
4. Lyttelton Harbour occupies the crater of an extinct volcano.
5. The Northern tip of New Zealand is free from frosts and is sometimes called the Winterless North. The Southern portions have severe frosts in winter—temperatures of 10° below zero have been recorded in Central Otago.
6. The action of water and wear on the rocks of Mount Egmont have supplied the huge quantities of iron sand on Taranaki beaches.
7. The combined length of the North and South Islands of New Zealand is just over 1,000 miles. Its broadest point is 280 miles.
8. Most of New Zealand's best harbours are not utilised as they are situated in remote localities.
9. Seventeen peaks in New Zealand exceed 10,000 feet in height.
10. Our nearest neighbour to the East is South America which is some 6,000 miles away. The fact that Australia is 1,200 miles away makes New Zealand one of the world's most isolated countries.



For the convenience of passengers the air routes have been shown on these maps by straight lines joining cities. It must be understood that aircraft are required to fly routes in accordance with radio aids (beams, beacons, etc.) and consequently it does not follow that the direct route will be flown.



CLOUD ATLAS

CIRRUS
Detached clouds of delicate and fibrous appearance, generally white in colour, and with silky edges. They may appear as isolated tufts, plumes, lines — either straight or curved, extending across the sky, or as a tangled web.

CIRRO-STRATUS
A thin whitish veil, not blurring the outlines of the sun or moon, but giving rise to haloes. Sometimes it gives the sky a milky appearance and at other times it seems to be made of tangled filaments.

CIRRO-CUMULUS
Small rounded masses or white flakes with slight or no shadows, arranged in groups or lines with ripples like sand.

ALTO-CUMULUS
A layer or series of patches of rather rounded masses of cloud. They may be more or less regularly arranged in lines.

ALTO-STRATUS
Appears either as a dense sheet of grey or bluish colour and fibrous structure, or as a thin sheet through which the sun or moon can be seen dimly (with no halo).

STRATO-CUMULUS
A layer or series of patches composed of rounded masses which may show considerable shading. It may form from stratus or change into stratus.

STRATUS
A uniform layer of cloud resembling mist—but not resting on the ground. Fine drizzle often falls from stratus cloud.

CUMULUS
Dense clouds with vertical development—upper surface dome-shaped—lower surface nearly horizontal. These clouds form in daytime — dissipate at night.

CUMULO-NIMBUS
Heavy masses of clouds with summits rising in the form of mountains or towers. Upper parts fibrous looking — often spreading to form "anvil top".

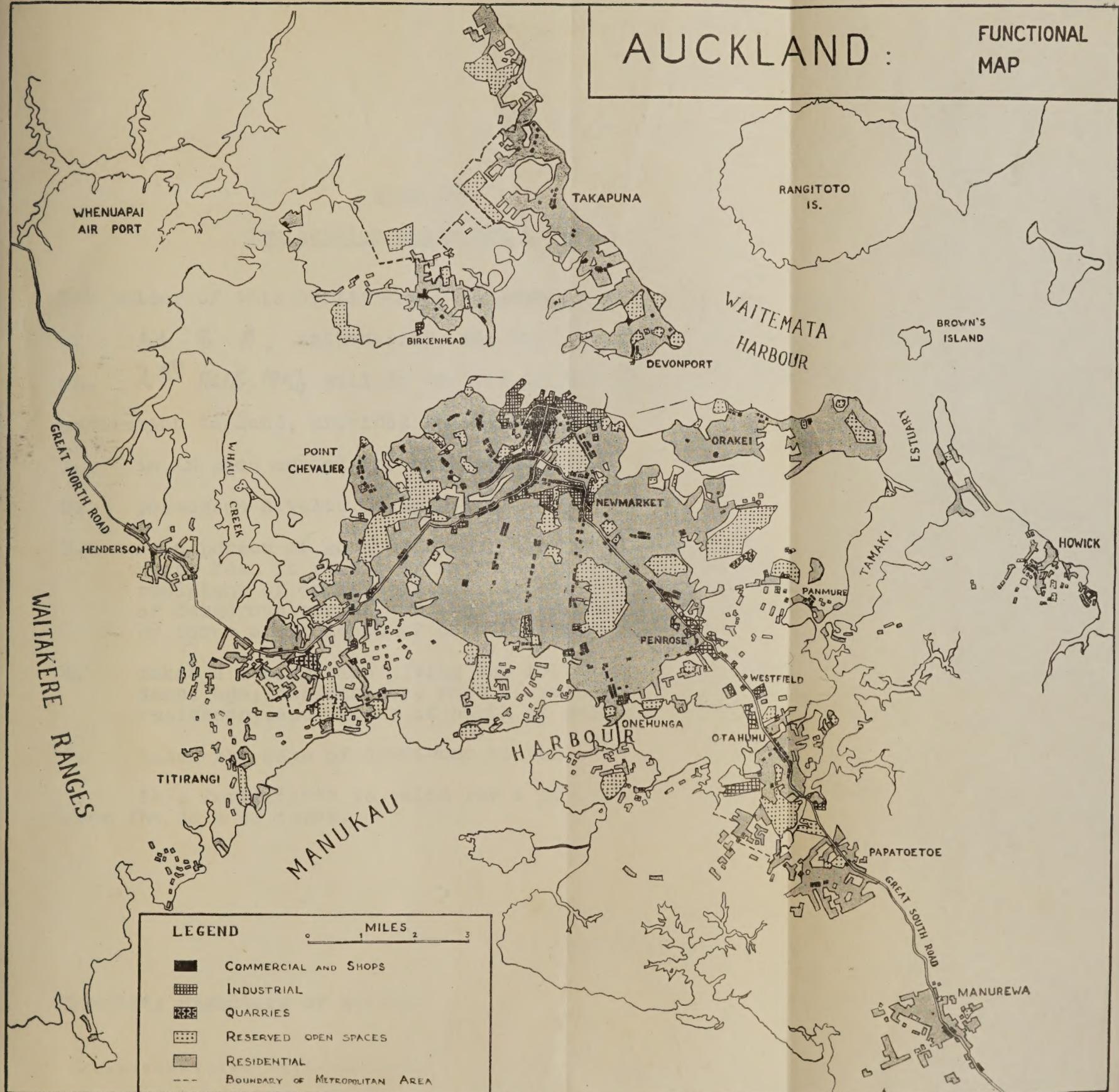
NOTES ON 5 TYPICAL NEW ZEALAND SCENES
The Chateau — in Tongariro National Park, North Island — rendezvous for skiers, mountaineers and trampers.
Mount Egmont, an extinct volcano (height 8,260 ft.) is seen from the farmlands of the fertile Taranaki province, North Island.
The Shotover River flows between steep, rocky gorges into the beautiful Lake Wakatipu, South Island. The view above is from Arthur's Point — four miles by road from Queenstown.
Mount Cook (12,349 ft.), on right, and Mount Tasman (11,475 ft.) seen across the still waters of Lake Matheson.
The Wanganui river is 140 miles long and can be navigated for approximately 120.

ROUTE MAP



AUCKLAND :

FUNCTIONAL
MAP



See Lister: Auckland City and Surroundings, a geographic outline.

No. 253.

New Zealand Government Office,
14 Martin Place,
Sydney. Australia.

Date: 12 . 1 . 49

FORM "B"

Immigration Restriction Acts.

The holder of this certificate, **CHARLES EDWIN KELLOGG**
of **U.S.A.**, nationality, who was born at **IONIA COUNTY,**
on, **2ND AUG. 1902**, will on arrival in New Zealand be granted
MICHIGAN.
permission to land, provided that the holder:

1. is in good mental and physical health;
2. possesses a valid passport;
3. is a person of good character and reputation, has never been in prison or in a mental hospital or the recipient of charitable aid, and is not a disaffected or dangerous person, or one who advocates the overthrow by force or violence of constitutional government;
4. makes a declaration giving the following information:
Name, age, nationality, race of people, occupation, residence, and places of birth of self and father; and
5. takes the oath of obedience to the laws of New Zealand.

This Certificate is valid for a period of three months from the date of issue.

Wm. Taylor
Commissioner.

Identity Signature of Holder:

L.

.....

For the last Government
to which it was
submitted.

1914

1914

Immigration Restriction Act

The holder of this certificate is **CHARLES EPWIN**
of 11 6 A. 1914

6-19-14

who was born on 10th
of 11 6 A. 1914

has arrived in New Zealand on
11 6 A. 1914

and is in good mental and physical health.

He is a native of New Zealand and has been
resident in New Zealand for a number of years.
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February 1

I am up at 5:45, pack, and make ready to go with Dr. Grange to Kaitaia, with only tea in the lounge. In Auckland, it is a very long way to the airport, through suburban districts and an area of small farms. These farms have fruit, mainly vines, vegetables, and dairies. Glimpses of road cuts show nearly white A₂ and heavily mottled B₂ horizons. The original vegetation included some of the kauri trees (Agathis australis).

After a short delay at the airport, we get into a small 10-passenger Lockheed plane at 8:30 and are soon in the air for Whangarei. At first we fly mostly over pastures for dairy cattle, although I see some vegetables and fruits on the undulating to gently rolling land. We are soon in the hilly land, with quite a bit of forest. These forests have fairly broad, fallowed fire strips (with roads) through them. I see plowable pasture on the small stream terraces, in the coves, and on some of the gently rolling land. Large areas are in pasture, including some fairly rugged land. Discontinuous clouds interrupt the view.

About 25 miles north of the airport, both agricultural and pastoral land is quite rugged. Near Warkworth, the land is strongly rolling for the most part, but largely

open (pasture?), most of which appears to be plowable. I see some gently sloping fields on narrow stream terraces, on gentle colluvial slopes, and in the coves. Even the rugged hill land west of Leigh is less than one-quarter forested. Our plane keeps well to the east, nearly or just over the sea. The Hens-and-Chickens Islands are a bit hazy through low clouds.

Along Dream Bay there is, generally, a large but irregular, gently rolling area of upland almost completely cleared. Across the Bay to the east from Oakleigh, the land is hilly with short, complex slopes. Yet the larger part is open and appears to be in grass, merging through scrub into low forest.

We are down at Whangarei at 9:15 and off again at 9:27 for Kaikohe. There are beautiful dairy farms under the plane as we fly north by northwest. Locally, this is very complex landscape, even if it were mapped on a scale of 1:20,000. About 20 miles out, one sees some elongated bare spots on the slopes, likely slips, some of which have grown into gully heads. In these hills, patches of cultivated soil are dark gray. Generally, the country becomes very rugged, with nearly one-half scrub forest. ^{1/}

^{1/} Added later: Much of this open land seen from the plane, I find later from the ground to be covered with gorse and other low shrubs and is not used for pasture.



Hoopers Pt
North Cape
FI (U) 8 sec 326

DF
PAURI RADIO
ZLU
R Bn
PAPAKAURI
WK
RACON
CODE W
CHANNEL P

KAITAIA
280 H 50
KAITAIA TOWER
3105 116.1 mc

morey
from
Taharua

1473-Water)
(Joins 1474)

173° 174° 175°
NAUTICAL MILES
180 190 200 210 220 230 240 250 260 270
To Auckland 236 FY

Feb 1

OHIA LAKE
14.6

Pahia
Rangitikei
Taharua

14.6

Feb 2
135°

16°E

AERONAUTICAL SYMBOLS

AIRCRAFT FACILITIES

AIRPORTS — COMPLETE FACILITIES Refueling services, complete repairs, shelter, and (where applicable) passenger or cargo services and/or seaplane ramp with hauling-out facilities.

AIRFIELDS or SEAPLANE PORTS — LIMITED FACILITIES Refueling services for normal and limited repair facilities.

SEAPLANE LANDPLANE



Military Base



Civil



Joint Civil and Military Base

SEAPLANE LANDPLANE



Military



Civil



Joint Civil and Military

LANDING GROUNDS and ANCHORAGES

- Landing Strip — Very limited or no facilities
- Landing Area — Very limited or no facilities or information thereon not complete
- Sheltered Anchorage — Very limited or no facilities
- Emergency Anchorage — Very limited or no facilities or information thereon not complete

AIRFIELD DATA

- 300 Elevation in feet
- L Minimum lighting; obstruction, boundary or runway lights and lighted wind indicator
- H Hard surface runway, normally all-weather
- S Normally sheltered take-off area
- 60 Length of longest runway to nearest hundred feet

ASANSOL
300 LH 60

TARANTO
3 LS 99

When specific information pertaining to landing facility data is lacking, the respective character is replaced by a dash (-).

ASANSOL
300 -H 60

TARANTO
3 -- 99

AIR NAVIGATION LIGHTS

Numerals in italics indicate elevation above mean sea level.

Rotating Light ----- 110 ★

Rotating Light (With flashing code lights) ----- ...★

Rotating Light (With course lights) ----- .15 ★

Flashing Light ----- ★

Flashing Light (With code) -----

Obstruction Light -----

Marine Light (Elevations of marine lights are above high water.) -----

Lightship -----

F—Fixed
Fl—Flashing

Occ—Occulting
Alt—Alternating

Gp—Group
R—Red

W—White
G—Green

B—Blue
(U)—Unwatched

SEC—Sector
sec—Second

Marine lights are white unless colors are indicated; alternating lights are red and white unless otherwise indicated.

MISCELLANEOUS

Mooring Mast -----

Dirigible Base -----

Prominent Transmission Line -----

Lighted Obstruction -----

Visual Ground Sign -----

Town having Visual Ground Sign ----- HO

High Explosives Area (Marked) -----

High Explosives Area (Unmarked) -----

Obstruction (Numerals in italics indicate elevation above sea level of obstruction top. Vertical numerals within parentheses indicate heights above ground.) -----

Ocean Station Vessel (Normal position) -----

As we approach Kaikohe, I see a rather large rolling plain that is mainly cultivated. There are many small wood lots and specimen trees in the fence rows and within the fields.

We are down at Kaikohe at 9:45 and off again at 9:53. We are soon back in rugged country, partly grazed, partly forest, and with considerable shrub. Just before reaching the airport of Kaitaia, we pass over the Victoria Valley with nice-looking farms. We are down at Kaitaia airport on a flattened hilltop in strongly rolling country at 10:11 a.m. Mr. N. H. Taylor and Mr. C. F. Sutherland of the New Zealand Bureau of Soils meet us. We drive through the small village of Awanui about 7 miles south of Kaitaia and start our tour back to Auckland.

Here there are imperfectly drained soils from clayey alluvium. Most of these are covered with grass. Seemingly, the farms are small and only moderately prosperous. At $1\frac{1}{2}$ miles, we are on rolling land with Kauri Podzol. ^{1/}

The original forest long ago was mainly kauri; now the vegetation is manuka shrub along with poor grass and other

^{1/} "Kauri Podzol" is used in these notes for the strongly developed Podzol or podzol-like soils having strongly marked A₂ horizons developed under the kauri and similar trees. Their precise correlation with the classical Podzols of cool, temperate, forested regions is extremely doubtful. The climate here is subtropical or nearly so. All, or part, of the A₂ is cemented. Locally, these soils are sometimes referred to as "gum land," because of the kauri gum found in the A₂.

ground cover. Here the land is strongly rolling and the soil is developed from mudstone. We stop about 2 miles east of Awanui, where I describe the soil and take samples on a slope of about 5 percent. The original kauri forest probably disappeared more than a 100 years ago. Since, there has been considerable reconstruction of the A_1 (which Mr. Taylor calls "melanization") by the present cover. Locally, this soil is called Wharekohe.

N.Z. Sample No. 1

A_0		Absent.
A_{10}	0-3"	Gray (5YR 5/1), fine sandy loam. Soft and finely granular. Held together by brown grass roots. (5YR 5/1 - gray) $\frac{1}{2}$
A_{11}	3-8"	Like the above, but less roots, although plentiful. (5YR 6/2 - pinkish gray)
A_{12}	8-11"	Light gray, mottled softly with light brownish-gray, light fine sandy loam. (Not sampled.)
A_2	11-19"	Hard, massive, cemented, white, loamy fine sand, with a few old light grayish-brown vertical streaks through which roots penetrate. (White - much lighter than 10YR 8/1)
B_1	19-20 $\frac{1}{2}$ "	Transitional. (Not sampled.)

1/ Color designations in parentheses at the end of horizon descriptions are those of air-dry collected samples filed at Beltsville.

- B₂ 20 $\frac{1}{2}$ -25" Reddish-black, mottled with black, massive, hard, fine sandy loam (ortstein). Irregular, gross cleavage planes with roots, which are flattened against the planes. The material is friable only under very hard pressure. (2.5YR 2/1 to 2/2 - very dusky red to reddish-black)
- B₃ 25-38" Transitional, nearly massive, but with well-defined, gross, conchoidal cleavage planes. Light yellowish-brown (10YR 6/4) in the interior of the large blocks and very dark brown (10YR 2/2 to 4/3) on the outside. There are flattened roots on the faces. The texture is generally fine sandy loam. The soil is friable under pressure. (Not sampled.)
- Grading into:
- C 38-42"+ Brown silty clay. The soil has some slight mottling and slight development of the coarse, conchoidal breakage. Fairly easily friable. (7.5YR 7/4 - pink)

This profile suggests a Ground-Water Podzol except for a strongly cemented A₂ and a strong relief. The land is very low in productivity. The soil is water-logged in winter and becomes very dry in summer. All of this area has been searched for the kauri gum. This means that at one time most of it was grubbed over, down deeply into the A₂.

We continue east. A mile further on, on smooth relief, we stop to look at Tekopuru sand. This soil is developed on a similar substratum and is generally like the last one,



K-1680 February 1, 1949
 New Zealand. Two miles east of Awanui. Profile
 of Kauri Podzol. (Wharekohe type)



K-1681 February 1, 1949
New Zealand. 2 miles east of Awanui. Landscape
on Kauri Podzol. (Mostly manuka shrub)



K-1682 February 1, 1949
New Zealand. 3 miles east of Awanui. Remnant of
old kauri stump in Tekopuru sand.

but coarser in texture. The surface is a bit peaty and reddish-brown in the A₁₂. Here we see clearly the exposed roots of the very old kauri stumps, which seem to be exceedingly resistant to decay. Here I also pick up some small rounded pebbles -- crop stones of the Moa bird.

The Maoris call these podzol-like soils keho. Along here I see some of the New Zealand flax (Phormium). It is used as a coarse fibre and the plant looks something like the Spanish Dagger. We pass rolling soils on the uplands with white A₂ horizons and yellow-brown B horizons called podzolized "yellow-brown earth" in the New Zealand Soil Survey. Flax is grown here in the swampy places, although it is said it will also grow on the uplands.

There are a great many transitional soils between the Kauri Podzol and the "yellow-brown earth." ^{1/}

Here a great deal of the open land is covered with low shrubs -- manuka, and the like.

About 11 miles east of the village of Awanui, we stop at an exposure of Ground-Water Podzol, with a deep white A₂ horizon that reminds one of the St. Lucie of Florida, but with a grossly mottled yellow, brown, and dark brown

^{1/} On the recent general soil map of New Zealand (1948), it will be noted that most of the soils are given a genetic name as well as a series or group name. Thus, names ending in "earth" are taken as zonal. Individuals are recognized as weakly, moderately, or strongly weathered, leached, podzolized, gleyed, or gammate.



K-1683 February 1, 1949
New Zealand. 11 miles southeast of Awanui. Ground-
Water Podzol, with L. to R.: C. F. Sutherland,
Dr. L. Grange, and N. H. Taylor.



K-1684 February 1, 1949
New Zealand. $8\frac{1}{2}$ miles south of Mangonui. View
on Rangiora clay -- a slightly podzolized Latosol (?).

ortstein at 3 to 5 feet. This soil is similar to some seen near Perth in Western Australia.

We pass through strongly rolling Kauri Podzol and various podzolized "yellow-brown earths." The soil here is now treeless and shrubby. Only a very little is even used for pasture.

I see a few road cuts^{1/} of red soil developed from basic igneous rocks. But again we must hurry, hurry. We drive along the gorgeous shore line of Doubtless Bay, with many beautiful beaches.

Just before 1:00, we enter Mangonui and have lunch at the local hotel. I am told that there are no frosts here at all. The average annual temperature is about 60° and the rainfall runs about 50 inches. Mr. Taylor tells me that in this area 13 $\frac{1}{2}$ pounds per acre of dust was collected during a two-day dust storm that originated in Australia!^{1*} We are back on the road south at 1:50. At about 8 $\frac{1}{2}$ miles, we stop to examine the soil. Although originally forested with kauri, the land is now essentially treeless. The cover is mainly shrub -- gorse or manuka, and the like. The land is strongly rolling, and I examine the soil on a slope of

^{1/} As in Australia, these are called "cuttings."

about 7 percent. This soil is called locally Rangiuru clay. I should say it is a Latosol that has been podzolized a bit.

A ₁	0-3"	Coarsely granular, very dark brown clay. Many roots.
A ₃	3-14"	Brown, mottled faintly with dark brown, clay, with granular to irregularly rounded nut structure. There is an irregular, coarse vertical breakage. The soil falls easily into firm, tough aggregates. The pH is about 4.5.
B	14-30"	Yellowish-brown (10YR 5/6), tough clay. There is slight vertical irregular cleavage. The soil digs out in coarse, rounded nut aggregates that are fairly easily friable for a soil so rich in clay.
C	30-50"+	Yellowish-brown clay, weathered from andesite, mottled with reddish-yellow and red. It digs out in fairly friable subangular nut. There are some boulders of D.
D	Below 50"	Reddish-yellow, rotten andesite, with dark reddish-brown coatings along the cracks.

Some profiles here have shallower upper sola, and others have deeper ones. This is regarded as a poor soil for pasture. Both lime and phosphate are needed for grass of even mediocre production.

We pass a few rather poor dairy farms, but most of the soil is not used.

In this area are some interesting old Maori forts, and I photograph one of these called Tara Tara.^{1/} Here I also photograph a brush fire on the steep slopes. Here, as elsewhere in tropical and subtropical areas, these fires are a great curse. They prevent regeneration of trees -- and trees are necessary to prevent the slips that grow into gullies on mudstones and a wide variety of similar rocks. The farmers have a mistaken notion that good pasture will follow these fires. But it doesn't, not unless the soil is properly limed and phosphated according to need. Then, in any case, the trees should be left on the steep slopes of the drainage ways and on the critical "noses."

About 14 miles southeast of Mangonui, we come into strongly rolling "yellow-brown earth," with some patches having a gray A₂ horizon at the surface. The land is fair for pasture. Some hills are not podzolized very much, since the kauri trees didn't cover them all.

We go across several areas of wet land -- old arms of the sea, now filled with various alluvial glei soils, some of which are salty and many of which have excellent pastures and meadows. We pass Kaeo, a little village situated in one of the good lowland pasture areas.

^{1/} "The essential parts of a beautiful princess." ^{2*/}

In this area are some interesting old karst formations, and I photographed one of these called Tars. I have also photographed a karst cave on the steep slopes. Here, as elsewhere in tropical and subtropical areas, these karst are a great nuisance. They prevent regeneration of trees and trees are necessary to prevent the soil from washing into gullies on mountains and a wide variety of similar rocks. The farmers have a mistaken notion that good pasture will follow these karst. But it doesn't, not unless the soil is properly limed and phosphated according to need. Then, in any case, the trees should be left on the steep slopes of the drainage ways and on the "critical" karst. About 14 miles southeast of Hanoi, we came into strongly rolling "yellow-brown earth," with some patches having a gray & horizon at the surface. The land is fair for pasture. Some hills are not podzolized very much, since the karst trees didn't cover them all. We go across several areas of wet land -- old areas of the sea, now filled with various alluvial clay soils, some of which are salty and many of which have excellent pastures and meadows. We pass Hanoi, a little village situated in one of the good lowland pasture areas.



K-1685 February 1, 1950
New Zealand. A few miles southeast of Mangonui.
Tara Tara Hill.



K-1686 February 2, 1949
New Zealand. About 6 miles south of Kawakawa.
"Egg-Cup" Kauri Podzol in "leached yellow-brown
earth."

Mr. Taylor tells me that shortly after white settlement in New Zealand, the percentage of Maoris in the population declined, but that now they are increasing relative to the European people. He says, "It will be good for New Zealand when the Maoris predominate, since they appreciate life more than the Europeans."

About 12 miles beyond Kaeo, we pass over rather shallow, dark brown soils on basalt, now being developed for pasture. These are difficult to develop, because the soils are high fixers of phosphate. Heavy dressings of phosphate fertilizer along with lime are needed to get clover. Some of the fields look very nice now. We look at the soil hurriedly. It is called a "strongly leached brown loam" or "ironstone" soil.

- | | | |
|--------------------|-------|--|
| A ₁ (p) | 0-3" | Brown to dark brown, granular, heavy loam. Contains some irregular, small, dark reddish-brown pebbles or old concretions, and some charcoal. |
| A ₃ | 3-11" | Dark reddish-brown, gravelly loam. The gravelly material consists of red, iron-rich, concretionary pebbles. The soil is relatively loose. The concretions make up nearly one-half of the mass. The other material is granular. |

This grades into:

B 11-24" Dark reddish-brown, gravelly loam.
This is granular, but slightly more
firm than the above. The percentage
of the red concretionary pebbles is
a good deal lower.

Merges into:

C 24" + Rotten basalt.

The surface is gently rolling to undulating. Where the profile is examined, the slope is about 5 percent. Beyond, some of this soil is undulating. Where the land is strongly rolling from dissection, the ironstone concretions are absent and the soil is more productive, even though it is fairly strongly leached. The best of this land without the ironstone is used for citrus as well as for good pastures and meadows.

Near the Kerikeri Crossroad, we drive a bit east and see citrus and other fruits, including tree tomatoes (from Ceylon). These orchards are protected by dense, thick-growing windbreaks of *Hakea* and *Lawsoniana*.

At a mile or so east of the Crossroad, we look at this good soil from basalt. It is very dark brown clay to 3 feet or more. The structure is mixed granular and irregular, medium, friable, blocky. Because of this structure, the soil is called locally "loamy clay." If cultivated carelessly, the soil is easily eroded.

We turn around at Kerikeri village and return to the Crossroad, and continue south. I see a small field of maize, but most of the arable land is in pasture. We are soon back on soil from basalt with the ironstone. Most of it is covered with poor scrub. The soil has poor internal drainage; and during dry periods plants suffer from drought. It is possible that the ironstone may have formed in places under the influence of a perched water table, according to Mr. Taylor and Dr. Grange. They say that if the soil is analyzed without screening, there is no more iron in this soil than in the good soil from basalt without the concretions. That is, the iron has not been added, but merely segregated.

At 4 miles beyond the Crossroad, we are again back on the "yellow-brown earths." I am told that the puriri and taraire trees are opposite to kauri in their effects on the soil. Their duff is nearly neutral. Thus, where all of these trees grow together in the forest, a strong mosaic of various degrees of podzolization is etched on the soil.

We drive on to a soil called locally Waimate North clay loam a little north of Ohaeawai and examine it in a badly disturbed road cut. The land is rolling to strongly rolling. The original forest was mainly the broad-leaved trees and

the soil is of the Brown Forest type. Now it is used mainly for pasture, although it is plowable.

A₁(p) 0-22" Dark red (2.5YR 3/6) clay. The soil is a mixture of medium granular and medium to small irregular blocky that falls into very fine angular blocky. Many roots.

B 22-36"+ The color and texture are about like the above. There are many roots. The soil has irregular, slightly prismatic, blocky structure. In place, the soil is tough, but it digs out in irregular pieces that fall fairly easily into small-medium irregular blocks that are friable with difficulty.

This soil grades gradually into slightly lighter red material of the same sort.

About 6 miles from Kaihohe, we pass onto undulating to rolling good brown soil from basalt. Formerly, this soil was used for wheat.^{1/} But now it is used for meadows and pastures and relatively small dairy farms. These soils from basalt vary greatly in their need for lime, even within the same field. I see a few small patches of maize.

We come into Kaihohe at about 5:30 p.m. for the night. The weather has been very nice, indeed, today.

Since I broke one of the straps of my back brace today, I first have a major sewing job. After dinner, there is a lot of chit-chat about various soil problems and experiences. Then to bed at 10:30.

^{1/} This wheat was said to have been grown and milled into flour by the Maoris for export to California during the early days of the Gold Rush.^{3*}

February 2

Like in Australia, breakfasts are very late in New Zealand and a late start to the field seems unavoidable. Finally we take to the road about 8:50 in the direction of Ohaeawai. This also promises to be a beautiful day. We drive south over the good brown soil from basalt and soon drop down into a low-lying area with some stony brown soil from basalt. Then, at $3\frac{1}{2}$ miles from Ohaeawai, we are in gently and strongly rolling country. The small farms have mostly cows, but there are some sheep.

Six miles south of Ohaeawai, we examine a soil called Kiripaka silt loam that is included in the "brown loams." Originally this soil had broad-leafed forest. Now most of it is in pasture for dairy cows. The surface is undulating to gently rolling. The slope here is about 3 to 5 percent.

N.Z. Sample No. 2

A _{1-p}	0-3"	Very dark yellowish-brown (10YR 3/4), softly and finely granular silt loam. Very many roots. (7.5YR 3/2 - dark brown)
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A ₃	3-11"	Dark yellowish-brown (10YR 4/4), softly and finely granular silt loam. The soil digs out in irregular, <u>very</u> friable nut-like aggregates. (10YR 3/4 - very dark yellowish-brown)
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- B 11-34" Dark yellowish-brown (10YR 4/4)
 silty clay loam. Imperfect prismatic
 structure that falls into easily
 friable medium nut. (10YR 4/4 -
 dark yellowish-brown)
- C 34" + A mixture of blue basalt and brown
 weathered material mottled with shades
 and with yellow.

We drive on south and are soon onto strongly rolling "yellow-brown earth" and pass over some Aponga soil -- a hydromorphic offshoot that owes its genesis to the very heavy parent material. In many respects, this soil can be called the hydromorphic offshoot of one transitional between Yellow Latosol and Yellow Podzolic.

About 9 miles beyond Ohaeawai, I photograph this soil on a slope of 5 percent or so, and a little further on examine the profile. Here the parent rock is a fine gray-wacke. Locally, the soil belongs with the Rangiora series -- a "strongly leached, imperfectly drained, yellow-brown earth."

- A₁ 0-4" Gray and grayish-brown, faintly and
 grossly mottled, heavy clay. The soil
 digs out in rather large clods that
 break into rounded, irregular, nut-like
 aggregates that are friable with
 difficulty. Faces of the blocks are
 brown.
- A₃ 4-17" Brown and yellowish-brown clay, coarsely
 and roughly prismatic. The soil falls
 into rather coarse subangular nut-like
 aggregates that are friable with
 difficulty.

B 17-26" Mottled gray, brownish-yellow, and yellow, very heavy clay. Some vertical cracking. The soil digs out in tough, angular, coarsely blocky aggregates. Some roots go through this soil.

Grades into:

C 26-36"+ Faintly mottled white and reddish-yellow, heavy, tough clay. The soil is lighter in color than that above. Digs out in coarse, angular prisms.

Nearby, low places have been covered with volcanic ash (?) and white glei has developed at 2 to 3 feet under a more granular, lighter-textured, yellow-brown solum. Although too small to indicate separately on maps, these spots support better pasture.

We pass Kawakawa. Beyond, there is mainly thin, rolling to strongly rolling soil with relatively poor pasture, cut up with small irregular alluvial valleys, partly wet. Some of the road cuts now show prominent gray A_2 horizons.

Here I see some slips on the steep slopes that are growing into gullies. As in the southern part of the Atherton Plateau in northern Queensland and on the steep slopes in western Ruanda, trees are necessary to hold the soil and prevent these slips.

As we go south, pastures on the uplands are better, partly, perhaps, because the soils are a bit lighter in



K-1766 February 2, 1949
New Zealand. 9 miles south of Ohaeawai.
Profile of Rangiora soil — a "strongly
leached, imperfectly drained, yellow-brown
earth" from fine graywacke.

texture. About 6 miles south of Kawakawa, I try to take photographs of an "Egg-Cup Podzol." This one is developed in the "leached yellow-brown earth." Such spots had kauri trees in contrast to the adjacent soil that had the broad-leafed trees like puriri and taraire. In the lowest place (near the spade that shows in the photograph) the white A_2 is more than 3 feet in thickness and is strongly cemented. The surface here has had some disturbance. The upper part of the profile is similar to that where the first sample was taken.

Norman Taylor tells me that it takes about 400 years for the kauri to produce the Kauri Podzol on soil material of medium texture and about 800 years on the heavy clays. Although kauri grow also on materials weathered from basalt, there the trees produce "brown loams," not the Kauri Podzol.

As we go on south, I see more strong podzolization on the "yellow-brown earth." I see a few "giant Kauri Podzols" where the erosion products of the A_2 horizons on higher slopes have accumulated in cove-like pockets and then been subjected to the influence of subsequent kauri forests. In such places, the A_2 horizon may be 10 feet thick and contain bits of charcoal and kauri gum.

These Kauri Podzols have been worked over by diggers for the kauri gum -- once in great demand for use in varnishes prior to the general use of tung oil. Sometimes digging for the kauri gum was combined with preparation of the land for grass. With the scrub removed, the land was dressed with lime and phosphate and seeded to grass and white clover.

Although less fertile, the pastures are better on the podzolized "yellow-brown earth" than on that not podzolized, because of the better physical condition of the surface soil. Many of the heavy soils become very wet in winter and are said to "pug" badly -- that is, the soil puddles and becomes very cloddy from the tramping by grazing animals. Once "pugged" it is often difficult to restore a good smooth surface. Rollers must be used to crush the lumps. But some of the best pastures in this area are seen on the Alluvial soils, many of which are imperfectly drained. 4*

About 3 miles south of Whakapara, basalt appears. We drive near the margin or over a long area of imperfectly drained soils on first bottoms or only slightly higher second bottoms. It is said that these Alluvials have deteriorated (decreased) in pH with the cutting of the forests on the uplands. This has resulted in an increased proportion of the A_2 of the Kauri Podzol in the recent alluvium.

Near Hikuragi, we pass beside "strongly podzolized yellow-brown earth" with glary white A_2 horizons from a near film to 18 inches in thickness. We pass Hikuragi -- a mining town where brown coal is taken. At the moment the mines are flooded and not worked. About 2 miles beyond, we pass over "moderately leached brown loam" with fairly good dairy pastures.

We pass Kamo. Here the rocks are mostly basalt and the soils relatively fertile with fairly good dairy farms and some nice gardens near the margins of the villages.

We arrive in Whangarei about noon and stop for lunch. We call briefly at the local agricultural office, and are on the road again at 1:30 toward Oakleigh.

At first we drive over Alluvials with glei lying just above Alluvials that are frequently flooded; then onto irregular, podzolized "yellow-brown earths." These occur on old terraces as well as on the rolling uplands of mud-stones. Again here are small dairy farms mostly with pasture. It is said that about 2 tons (2240 lbs. per ton) of ground limestone are used per acre here -- enough to give a 3-inch layer of soil with 60 percent base saturation. Many of the farms here have been developed in the past 10 or 15 years. It is said that often a pasture will hold for a 20- to 30-year

period after the initial preparation in seeding, or as long as the white clover can be held in the mixture. But in regions of low rainfall, it is said that pastures must be reseeded every two to four years, as the white clover goes out.

Some of the steeper slopes show considerable sheet erosion where the scrub has been fired and the land not laid down to grass with proper liming and phosphating.

After 12 miles or so, a part of these dairy farms are considerably larger on a broad area of imperfectly drained associates of the "yellow-brown earth" on a terrace. Also in the patterns are Bogs, Half-Bogs, and Gray Hydromorphics. In these pastures some sheep are grazing along with the cattle.

We pass Waipu and stop 7 miles south to look at the Marua soil -- "strongly weathered yellow-brown earth."^{5*} The soil is strongly rolling to hilly, and I sample the soil in a road cut where the slope is about 6 percent. Long ago this soil had a luxuriant broad-leaved forest. Now it has a cover of bracken, "buffalo grass," and other grasses. The surface has undoubtedly been disturbed a bit.

N.Z. Sample No. 3

A₁₀ 0-2(4)" Dark brown, mottled with brown, silty clay loam. Coarse granular to fine subangular nut. Many roots. (10YR 4/3 - brown to dark brown)

- A₁₁ 2-4(10)" Dark brown, mottled with brown, silty clay. Coarse, irregular, prismatic. Digs out in clods that fall into subangular medium to large nut. (10 YR 5/3 and 5/4 - mottled brown and yellowish-brown)
- B₂ (4-10)- 24(20-26)" Yellowish-brown, mottled with brown and reddish-yellow, heavy clay. Tough. Irregular, prismatic breakage. Soil falls into angular medium to coarse angular nut. There are many dark brown, circular channels about 1/8 to 1/4 inch in diameter, likely from roots.
- B₃ 24-33" Brownish-yellow, mottled with gray and reddish-yellow, tough, heavy clay. Nearly massive. Digs out in imperfect coarsely blocky. Several brown circular root channels.
- Grades into:
- C 33-60"+ Reddish-yellow, massive, silty clay, rather finely mottled with shades and with a bit of gray and red. With depth, the mottling is coarser and the percent of clay decreases until the rotten graywacke is reached.

In the road cuts there is often an overhang of about 6 inches or so of A₁ due to the concentration of strong roots.

Here the original forest consisted mainly of rimu and taraire. Now it is chiefly manuka shrub, cabbage tree, tree fern, bracken, nikau, and the like.

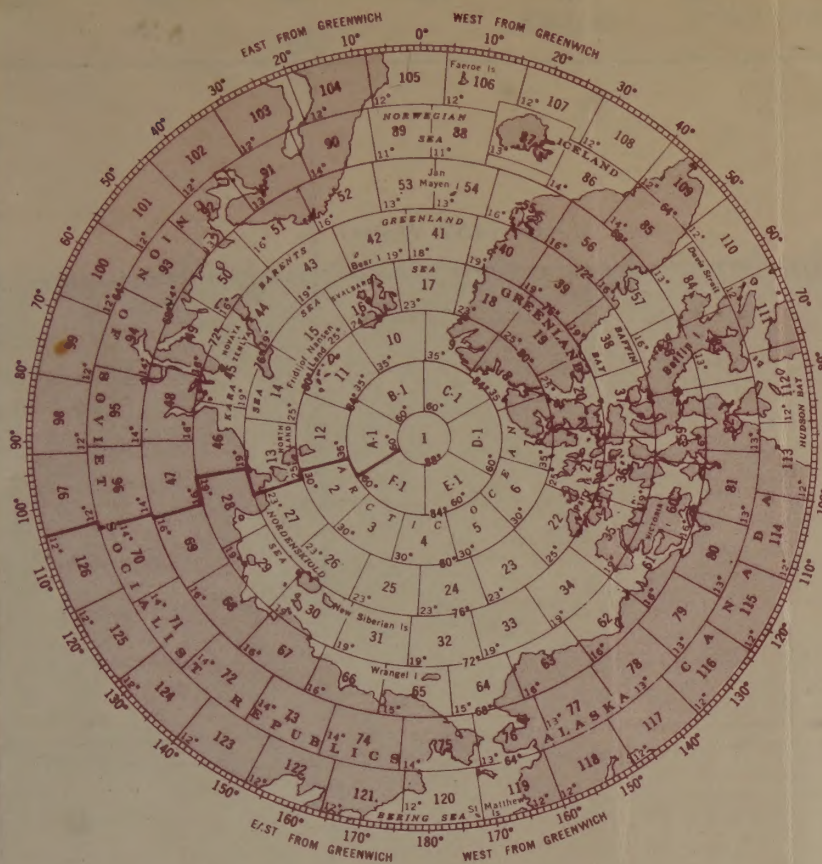
The soil would likely be included with the Yellow Latosols, although the clay seems most too plastic and sticky.



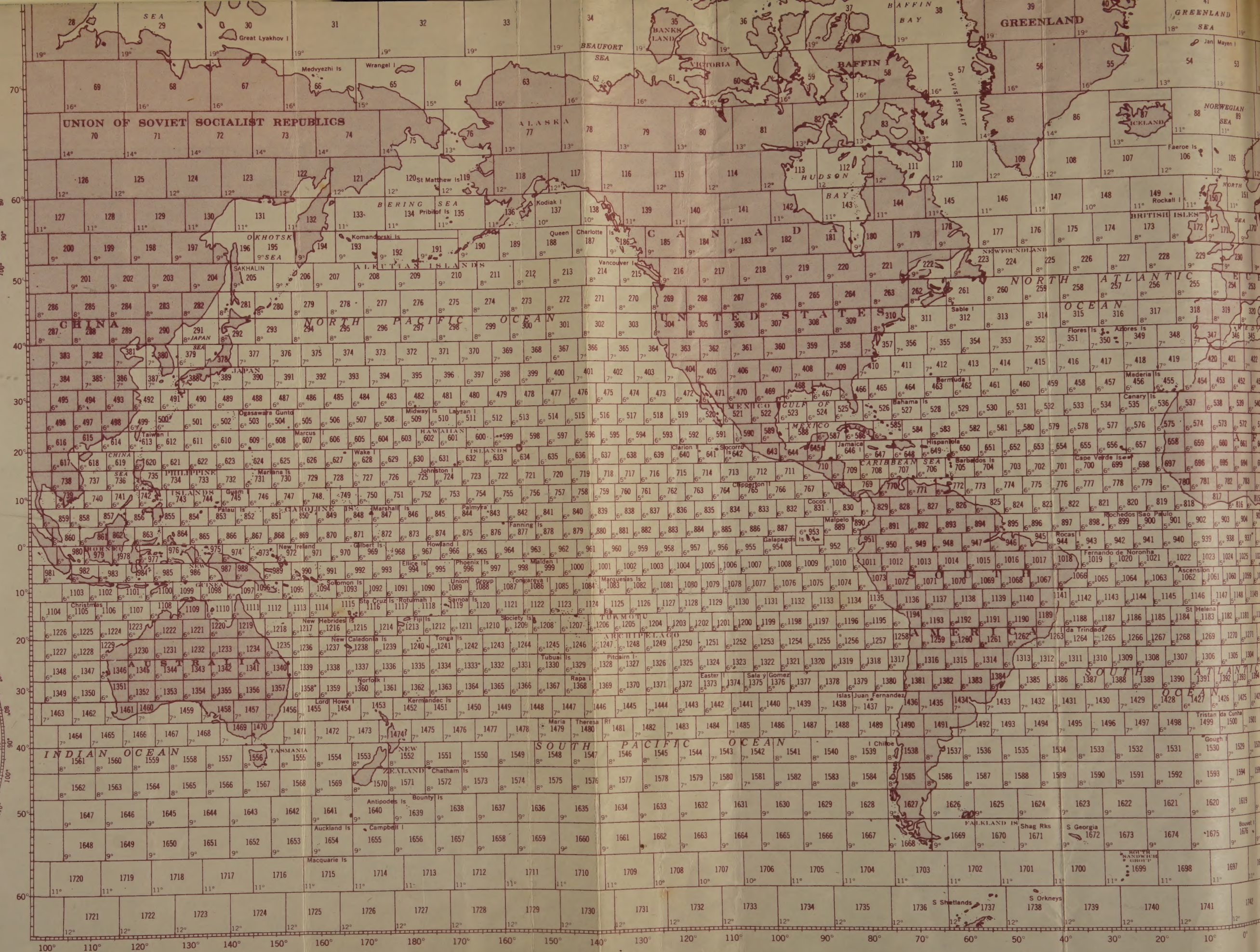
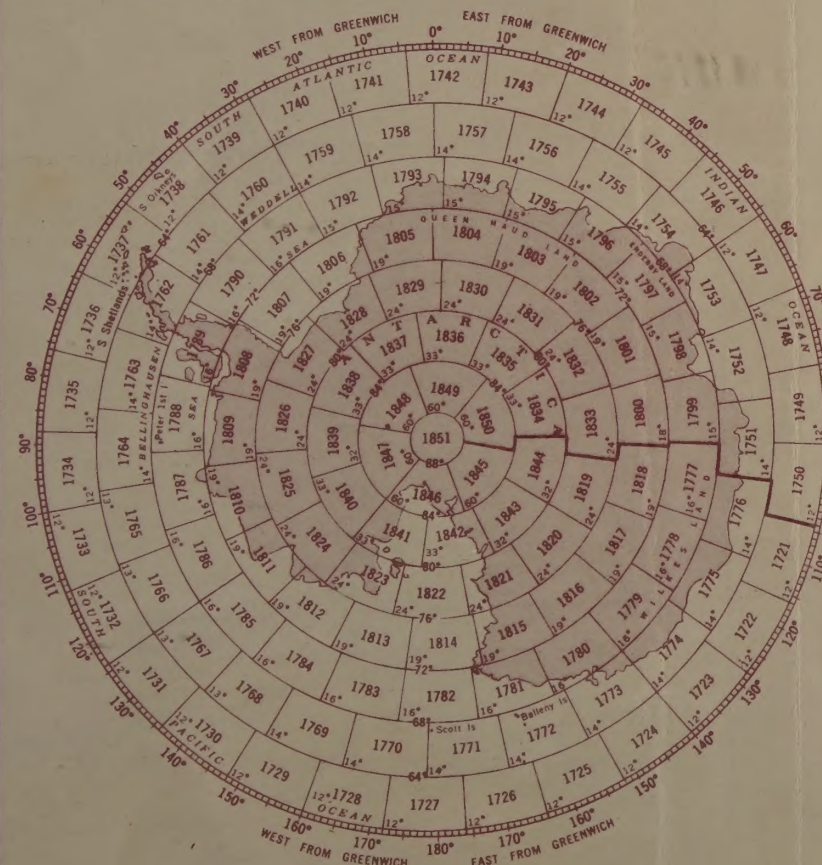
K-1688 February 2, 1949
New Zealand. 7 miles south of Waipu.
Landscape on Marua -- a "strongly weathered yellow-
brown earth."



NORTH POLAR AREA



SOUTH POLAR AREA



WORLD AERONAUTICAL CHART INDEX

Scale of Series 1:1,000,000

Here I see sheep grazing on very hilly soil indeed. I stop to photograph a kauri tree growing on "leached yellow-brown earth," but there is no white A_2 yet.

We pass Kaiwaka. Here there is a small area of undulating to rolling Rendzina soil -- Arapohue. The surface 12 inches or so is granular, very dark grayish-brown clay, lying over white, limy marl. This is a good soil for pasture, but we are soon back on the "leached yellow-brown earth."

Norman Taylor says that well-developed Podzols exist everywhere in New Zealand where the mor-forming trees grow. The process goes faster and "easier" in the southern part of the country on the less weathered materials (less chemical clay) than in the north. Reconstruction of the A_1 is also faster/^{than}in the north. He says, however, that in the north podzolization goes faster on the sands.

As we drive south, the road cuts indicate remarkable variations in the thickness of the glary white A_2 horizon, apparently related directly to differences in the degree of podzolization as stimulated by kauri and other kinds of trees.

We pass Te Hana and Wellsford. Here the land has been settled somewhat longer and farms are better. Most of them are dairy farms with some sheep.



K-1689 February 2, 1949
New Zealand. North of Kaiwaka. An isolated
kauri tree on "leached yellow-brown earth."



K-1767 February 2, 1949
 New Zealand. $1\frac{1}{2}$ miles south of Wellsford. View
 on "strongly leached yellow-brown earth."

The dairy cattle, especially in the north, are a bit disappointing. Jersey, Guernsey, and Milking Shorthorn seem to predominate. The better farms have only one breed, but on the little farms there are many brindles, and some are not in very good flesh or have poor conformations.

We shortly pass into a very hilly area of sandstone with bands of volcanic tuff. Most of the soils are yellow. They are not used for pasture, and the cover is mainly shrub and scrub forest.

We pass Workworth. For about $1\frac{1}{2}$ miles I see some small orchards along with the dairying. Here again there are slips on the hills. Things are too nearly tropical for the grass to hold the heavy clays on the strong slopes.

We examine the "weakly leached yellow-brown earth." Here the soil has a slightly darker and thicker A_1 and a shallower solum. But still the profile has a very heavy B horizon, with coarse, blocky structure. This soil is said to have a higher base status and to be better for farming than the more ^{leached} ~~pedzolized~~ one.

We pass Waiwera and stop about 3 miles south to examine and sample the Hukerenui soil, a "moderately podzolized yellow-brown earth." Originally the soil supported a kauri forest. Now the principal cover is manuka shrub. Good

The dairy cattle, especially in the north, are a bit disappointing. Jersey, Guernsey, and Milking Shorthorn seem to predominate. The better farms have only one breed, but on the little farms there are many breeds, and some are not in very good flesh or have poor conformations. We shortly pass into a very hilly area of sandstone with bands of volcanic tuff. Most of the soils are yellow. They are not used for pasture, and the cover is mainly shrub and scrub forest. We pass Workworth. For about 1½ miles I see some small orchards along with the dairying. Here again there are alps on the hills. Things are too nearly tropical for the grass to hold the heavy clays on the strong slopes. We examine the "weakly leached yellow-brown earth." Here the soil has a slightly darker and thicker A₁ and a shallower solum. But still the profile has a very heavy B horizon, with coarse, blocky structure. This soil is said to have a higher base status and to be better for farming than the more ^{leached} / ~~acidified~~ one. We pass Wainers and stop about 3 miles south to examine and sample the Hokeran soil, a "moderately podsolized yellow-brown earth." Originally the soil supported a kauri forest. Now the principal cover is manuka shrub. Good



K-1690 February 2, 1949
 New Zealand. 13 miles south of Workworth.
 View on "weakly leached yellow-brown earth."

pastures may be had with lime and phosphate. The soil is rolling to strongly rolling. The slope is about 10 percent where sampled.

N.Z. Sample No. 4

- | | | |
|----------------|---------|---|
| A ₁ | | Essentially absent. |
| A ₂ | 0-5½" | Light gray to light brownish-gray, heavy, fine sandy loam. Massive, except for some very slight platiness. Vesicular, brittle, fairly easily friable to irregular, fine granular or powder. (Pieces of kauri gum were found here.) (10YR 7/2 - light gray) |
| B ₁ | 5½-7" | Transitional. (Not sampled.) |
| B ₂ | 7-23" | Silty clay, with coarse vertical cracking and large blocky aggregates. On the inside, these are yellow, mottled with gray; on the outside, they are dark yellowish-brown. There are many gray and brown circular root channels. The blocks have many flattened roots on their sides. (Mainly very pale brown and pale yellow) |
| B ₃ | 23-36" | Transitional. (Not sampled.) |
| C | 36-60"+ | Pale yellow and gray mottled heavy silty clay that digs out in large coarsely angular blocks. |

In the sloping banks of the road cuts, after exposure for a long period, the large prisms develop caps superficially resembling those of solodized-Solonetz.

It is now very late and we have far to go. I remark aloud that I don't see why I commonly get caught out so late. Norman Taylor says he knows; but he doesn't tell me.

We pass over a complex, rolling area of rather strongly podzolized soils with glary white A_2 horizons, from interbedded clay, rock, and limestone. Where the limestone comes to the surface are small spots and strips of the Rendzina.

We stop in Devonport for dinner, since we would be too late for dinner in Auckland. We cross on the ferry, and I am back at my hotel at 7:45.

Never have I seen soils of such heavy texture, with these glary white A_2 horizons even to several feet in spots. The so-called "Egg-Cup Podzols" are dramatic indeed. It is a pity that I had no opportunity to see these in the virgin state in order to study the leaf litter. I am told that the few remaining kauri forests are in the west of this North Auckland part of the North Island and are mostly on basalt. On this material, kauri does not produce a soil with the striking podzol-like morphology.

The A_2 is not distinctly platy; indeed, it is often cemented hard. Nor is it always underlain with the usual orterde or ortstein. Likely some powerful organic reducing

agent is produced through the decomposition of the kauri litter. I doubt that these powerful effects can begin to be accounted for through the low base status of the kauri litter alone. Certainly these soils should be called Kauri Podzol or something like that to differentiate them clearly from the classical Podzols.

In much of the area traversed today, the most dependable pasture is on the Alluvials or the low, imperfectly drained terraces, especially the pastures used for dairy cattle. A great many of these pastures could be enormously improved by just a bit better job of clearing, mainly grubbing, and mowing, as practiced by the best farmers.

It seems to me that the men here in the Soils Bureau have done well to concentrate on getting their local soils series described and arranged so that their system of classification takes account of the soils to be dealt with and is internally consistent. It is good that they have not been eager to adopt outside names of uncertain connotation. Even though some of these group names in New Zealand will likely not be acceptable in the international system, the scientists here have avoided skewing their own system in terms of outside definitions or of names poorly defined or too broadly defined.

From the conversations of the last two days, I get the impression that genetics may be just a trifle over-emphasized in relation to morphology -- perhaps just a bit too much of "what-ought-to-be" in the naming. This may be a wrong impression, and certainly there is nothing serious. But there is a long way to go for an understanding of the genesis of the mature Kauri Podzol, which merges into the common intrazonal Ground-Water Podzol as found in many parts of the world.

And so to bed.

Issued by the Immigration Officer,
Department of Labour and Employment
Wellington, New Zealand

October, 1947.

ADVICE TO SETTLERS

The Government welcomes the arrival of new settlers in New Zealand and is anxious to do everything possible to assist them. At the present time the difficult housing situation prevents the Government from offering new settlers, other than those arriving under the Government immigration scheme, immediate official assistance towards securing suitable housing or other accommodation. Temporary hotel or boardinghouse accommodation can sometimes be arranged through the Government Tourist Bureaux. Other forms of assistance are freely available and will be given willingly.

The Department of Labour and Employment is available to assist all residents and all newcomers to obtain suitable employment, and the Immigration Division of the Department will gladly assist any new settlers, whether they arrive under the Government immigration scheme or not, to overcome any initial difficulties, and advise them on any matters in which they may require assistance. The Department's Head Office in Wellington is situated in Hope Gibbons Building, Courtenay Place, and this is also the headquarters of the Immigration Division. The Department has District Offices at—

Ashburton	Invercargill	Rotorua.
Auckland.	Lower Hutt.	Taumarunui.
Blenheim.	Masterton.	Tauranga.
Christchurch.	Napier.	Timaru.
Dunedin.	Nelson.	Wanganui.
Gisborne.	New Plymouth.	Wellington.
Greymouth.	Oamaru.	Westport.
Hamilton.	Paeroa.	Whangarei.
Hastings.	Palmerston North.	

Government has also promoted the establishment of Immigration Welfare Committees in all the cities and towns enumerated above, and these Committees may be contacted through any District Office of the Department. The Committees are entirely voluntary organizations and are not under Government control in any way. The Returned Services' Association, local bodies, and both employers' and workers' organizations are represented on these Committees, as are many other organizations.

The Immigration Welfare Committees, whose members are private citizens, exist for the purpose of making available to new settlers the services of organizations interested in assisting and advising them, and generally enabling new settlers to be satisfactorily settled in and absorbed into the community. The Committees are able to assist newcomers in many ways, particularly by arranging contacts and introductions for them.

Issued by the Immigration Division,
Department of Labour and Employment,
Wellington, New Zealand.

October, 1947.

February 3

Before breakfast I sort out my film and write letters. Afterwards, I go to the University and get my mail. I make arrangements for a tour on Saturday to look at soils near Auckland and on Sunday to see the kauri forest. Mr. J. K. Taylor had had my glasses repaired while I was away yesterday, but they still look very fragile.

I go into the Forestry Section of the Pacific Science Congress for a while. (I had missed the opening exercises yesterday.)^{1/}

During the luncheon recess, I go down to the city and arrange bookings back from Christchurch to Auckland and from Auckland to Honolulu. This takes a lot of time, and then I need to go to the bank. On a trip like this, one spends a very large part of the time just doing business and filling out forms.

I discuss the possibilities of some highly qualified American soil scientist studying in New Zealand through the operation of the Fulbright Act with Dr. Dixon. I give him a list of American soil scientists who would be qualified.

^{1/} There will be no attempt in these notes to review in detail the papers given at the Pacific Science Congress, nor a list of delegates, since these proceedings will be printed in New Zealand and made available. Many of the more important papers are on file in mimeograph form in my office.

First in the afternoon there is a preliminary meeting of the Research Planning Committee in Agriculture with Dr. Archibald of Canada as chairman. I agree to work with the others on the statement for soil and land classification. Then I go again to the meetings of the Forestry Section. Mr. C. Marshall of Fiji becomes quite elegant. He says the local timber supplies in Fiji could be developed, but not "while Canada and the United States maintain their output by dumping their surplus timber on the Fiji market".

J. Allsop gives a descriptive and elementary paper on shifting cultivation in Burma. He strikes one as a bureaucratic British colonial.

Most of the discussion is against shifting cultivation as a system. I try to point out that shifting cultivation can be a good system or a bad one. There are hundreds of millions of acres in the tropics that couldn't be farmed without some sort of shifting cultivation. I try to explain the corridor system and how this method can be used by natives for increasing production without the invasion in the fallow of imperata and without erosion. I suggest that foresters might take some interest in helping to improve the system and give consideration to the types of trees that would be most useful for restoring the fallows. But most of

the foresters here are interested exclusively in saw logs and not much in the relation of forestry to soil improvement or watershed protection.

After the session, I go down to the city again and finally get my tickets. I stop in a book store and I am told that there are no worthwhile New Zealand novels or other books about New Zealand! It appears that New Zealand had only one Katherine Mansfield, and I suspect that most don't care if they ever have another. The lady running the book shop seems quite intelligent, and when I tell her that my reading of Katherine Mansfield's early stories did a great deal to make me want to come to New Zealand, I can't tell whether she is shocked or simply much surprised.

At dinner in the hotel tonight, a white Dutch colonial (Baas-Becking) and a former British colonial now in New Zealand (^{6*/}Entrican) point out very forcibly to me that the Atlantic Charter was and is a farce. One says that "the Whites must govern firmly . . . The natives must be treated as children -- firmly, even cruelly, if necessary, in order to be kind to them." And a great deal more in the same vein, with particular criticism of Americans. Unfortunately, there is something to what they say, mainly because Dutch

and British colonial administrations did so very little to educate the natives, establish local industry, or prepare the natives for self-government. Now, on their own, the natives may cut forests, increase the erosion hazard, and so on. But in my judgment, there is no going back. Unless we can find some kind of middle road, serious trouble is ahead in some of these crowded tropical areas. I did agree with Bass-Becking that these big mono-culture schemes, like the British groundnut scheme in Africa, are probably not sound. But many of the Dutch colonials, and some of the British ones, equal the most selfish leaders of American labor organizations and trade associations for plain arrogance.

I go to bed early, wondering what good it would possibly do for me to try to think through a program of world food production. I seem to be merely an insignificant atom in the face of an almost infinite mountain of difficulties.

February 4

I sleep late this morning, and am not up until 6:45. Then morning tea and the paper. There is much to-do about Mr. Eden's visit to New Zealand and exceedingly laudatory appraisals of him fill the conservative press. They couldn't do much more for a "second coming."

I go early to the conference and put up the exhibits received yesterday from my office in Washington. About 9:30, the first soil science meeting begins with Mr. J. K. Taylor in the chair. Some of the papers are read in abstract. D. A. Campbell of New Zealand gives a paper on Modifying farming to achieve soil conservation. This is fairly good. He shows pictures of the effects of over-grazing, of the origin of slips and their growth to gullies in the North Island, and of sheet and rill erosion on slopes in the South Island. He suggests the usual measures -- increase of soil organic matter, fertilizer dressings, fire control, rabbit control, controlled grazing and controlled cutting of forests, and contouring. He gives greatest emphasis, and I agree, to fire control and to the use of phosphatic fertilizers. Preliminary trials for top-dressing hill pastures with 2 cwt. of superphosphate per acre, from the air, are good.

Mr. Laird reads a paper by A. Leahey. The paper of Mr. L. E. Smythe of Fiji is abstracted. It is said that this paper includes a summary of the soil data obtained up to the present and the plans of a new governmental scheme for agriculture. It is said this includes a general scheme for soil classification in Fiji. The problem there is serious, since the Europeans and settlers from India occupy most of the best land, leaving the native Fijians with the poor land.

After a short intermission, Mr. H. S. Gibbs gives an interesting paper on The effect of cyclic salts on coastal soils. He suggests that many soils in New Zealand receive a great deal of salt, especially where the rainfall is not too high, and these are regarded as slightly, moderately, or strongly solonized. The effects are more noticeable in the sandy soils than in the very heavy ones. He says the effects are important up to a mile from the coast near Wellington. Slight effects have been observed up to 6 miles, but none beyond that. He points out that in many soils in New Zealand, podzolization, gleization, and solonization are all important, and that it is very difficult to sort out the separate effects of each. He has found no noticeable effect of the cyclic salt on the exchangeable potassium.

Then Dr. J. K. Dixon gives an excellent paper on The district chemists in soil surveys. This is followed by an interesting general discussion about the coordination of the various phases of soil science and the need for more general soil scientists in all phases without sacrifice of scholarship in individual specialties.

Mr. A. C. S. Wright gives his paper on The rôle of biotic surveys in the soil studies so rapidly that one can only understand a little. He illustrates the importance of biological data with examples from current work on copper and boron deficiencies.

I return to the hotel for lunch, and then wrap up my black-and-white film to send to Wellington for developing. I walk over to Dr. Grange's hotel and we mail these and some kodachromes.

Then, about 3:30 p.m. I go with Dr. Dixon to a garden party at the home of Sir Frank Mapping and Lady Mapping. The garden is large and very nice. Especially good are the tuberous begonias and the orchids in the glasshouses.

In the evening, I have some discussion with the Australians about New Guinea. Apparently the administration of this Territory is exceedingly backward and not interested in scientific work for its development and improvement.

Early to bed.

February 5

Today we are to have a trip in the country. The sky is cloudy and the weather forecast is for rain. Each morning here I am brought the New Zealand Herald. It tries to imitate the London Times: the classified ads are on the outside and are followed by the sports. It is not simply conservative; it seems to have an almost naive, pre-war -- pre-World War I -- view of the world. Here it is always the "British Empire" -- no weak talk about the "Commonwealth." The comments about Mr. Eden and his visit here are so sticky that they must even embarrass Mr. Eden and his friends.

I go to the University for the soil tour north of Auckland. We leave about 9:15, but then after a little way, have a delay in order to change buses.

We go out on the road by New Lynn and toward Titirangi. As we leave the city, the road passes through a hilly area of very nice, scattered, suburban residences. Most of the land is in scrub, with some regeneration of forest trees. There are small gardens and orchards and even some small pastures. This is certainly a pretty place for a home.

We see a few specimen kauri trees, but most of the forest is scrubby and has many tree ferns and cabbage trees.



SEE PAGE 1



In the road cuts I see some red soils with brown surface soils -- some sort of Latosols. (It is almost impossible to study soils on these bus trips, so I shall need to relax and enjoy the scenery.)

We stop for a moment for a view over Manakau Harbor and the ^{Lower}/Nihotipu Dam -- an earth dam recently completed for storing city water. In a road cut nearby, I see a "brown granular clay" -- a very heavy soil from andesitic tuff. The very surface is granular for 2 or 3 inches. Beneath, the soil has an angular nut structure. At 12 to 18 inches, reddish mottling appears and the soil grades into the mottled gray and yellowish-red rotten rock.

I photograph an untouched profile in the road cut, showing slight podzolization under an old kauri stump. This represents the very beginning of the "Egg-Cup" Kauri Podzol on the "brown granular clay." There is a medium gray A₂ under a heavy yellowish-brown soil with some dark reddish-brown staining.

We continue generally on a ridge road with mostly scrub and a thin forest with some patches of fair second growth. Through gaps in the hills, we have gorgeous vistas of farm land and villages near the coast. Then we stop at a little inn for morning tea. Beyond Swanson we go into strongly



K-1691 February 5, 1949
New Zealand. Northwest of Auckland. Looking
toward Nihotipu earth dam.



K-1692 February 5, 1949
New Zealand. North of Auckland. N. H. Taylor,
G.W. Robinson, L. Grange.

rolling land with "podzolized yellow-brown earth" soils along with "brown granular clays." About one-half of this land is developed for pasture. The "brown granular clays" are said to fix phosphate strongly and to have a high lime requirement. It is also difficult to prepare a satisfactory seed bed. The steeper slopes are in scrubs, mainly manuka, and we see some "Egg-Cup" Kauri Podzols in the road cuts.

Beyond Waitakere there is gently rolling land with a large percentage under grass. Part of the land is undulating to nearly level. There are some imperfectly drained Alluvial soils, cut up with old stream courses and levees. A little hay is being harvested. There are some nice specimen trees in the fence rows, mostly Pinus radiata. It is said that butter-fat production runs about 100 to 120 pounds per acre on the upland, with perhaps 140 pounds per acre on the Alluvial soils. The grasses in the pastures are mainly Paspalum dilatatum, perennial rye grass, white clover, and browntop (Agrostis). Most of the cows seem to be Jerseys. There are a very few crops besides the meadows and pastures.

It begins to rain gently.

Beyond Waimauku, we stop to look at some stabilized "sand dunes." These have a dark grayish-brown light sandy



K-1768 February 5, 1949
New Zealand. North of Auckland. Upper profile
near an old kauri stump in a very weak "Egg-Cup"
Kauri Podzol on "brown granular clay."



K-1693 February 5, 1949
New Zealand. North of Auckland. Landscape
on "slightly podzolized, strongly leached
yellow-brown earth."



K-1694 February 5, 1949
New Zealand. North of Auckland. Undressed road
cut of "slightly podzolized, strongly leached
yellow-brown earth."



K-1769 February 5, 1949

New Zealand. North of Auckland. Scrub on left and properly prepared pasture on right with phosphate, lime, and seeding. Soil is Waikare clay. It always has a mosaic of varying degrees of podzolization.

loam surface soil with a good turf. Beneath is dark yellowish-brown sandy clay loam with some coarse vertical cracking and with irregular medium nut structure. At 30 inches, it is yellowish-brown (10YR 6/8) sandy clay. This is tough, nearly massive, with some vertical breakage. There are many tiny white specks. At about 6 feet, there is white pumiceous sand, streaked and finely mottled with yellowish-brown. Certainly there is a much higher content of clay-forming minerals in this material than ordinarily thought of in dune sand. (It rains hard.) Between the "dune" ridges are peaty glei soils. Good pasture is maintained on both. To the west of the road and some distance away is a fine forest planting of radiata some 12 to 15 years old for stabilizing young dunes that threaten to engulf the farms here.

We then pass over a considerable area of nearly level alluvial land with imperfect drainage, used mostly for dairy pasture and meadows. It is estimated that the combination of rolling land from pumiceous sands and the Alluvial soils together give about 140 to 150 pounds of butter fat per acre. The soils to the far right are in grass except for forest or scrub on some of the steeper slopes. We have lunch in Parakai. About 2:00, we go north and see some sheep

grazing with the dairy cows. On good average pasture here, one cow grazes on two acres. They try to use paspalum, rye grass, and white clover. Although it is a good practice to mow the pastures, some farmers fail to do so. The farms run about 100 to 110 acres of grass with 30 to 40 cows. Here only 10 percent of the grass is cut for hay.

We stop in some of the strongly rolling "slightly podzolized, strongly leached, yellow-brown earth" to note the contrast between wild scrub land and the pastures developed through proper fertilization and seeding. The local soil here is called Waikare clay, which always exists with a variable mosaic according to the degree of podzolization, depending upon the kauri in the original forest. A little further on I see one poor field of turnips on this rolling soil. They shouldn't be attempted here.

We stop at Albany for afternoon tea. It now sets in to rain in earnest, and we return to Auckland about 5:45.

After a very light dinner, I am early to bed.

February 6

There are no papers on Sunday in Auckland, and breakfast is late. The weather is very bad. I hope it clears for a field trip this afternoon. This morning I write out the proposals for recommendations of the Agricultural Section on land and soil classification and for a field conference in the Philippines during the next Pacific Science Congress.

At noon it is still raining hard. Mr. Wright tells me that he is afraid it would be exceedingly unpleasant to see the kauri forest, since it is far off the road. This is a great pity. I still haven't had time to catch up on all of my "office" work, but I should rather let that go.

In the afternoon, Mr. Wright and Norman Taylor come in for a little chit-chat. Otherwise, I spend a quiet day and evening. It still rains as I go to bed.

Later, I have a brief conference with Mr. Archibald and others at which Mr. Holt suggests that the lands in the Pacific be classified by the so-called "use-capability" method of the Soil Conservation Service -- a method that he doesn't understand.

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February 7

This morning begins gray and wet. After breakfast, I go to a meeting of the Research Planning Committee for the Agricultural Section. There is a great deal of discussion about what standing committees to establish and how they may operate. One can't expect much from committees where the members are scattered over the whole Pacific area and where there are no funds for travel or for a secretariat. We tentatively decide to have one on forestry, one on soil and land classification for production and conservation, one on crop improvement, and one on livestock improvement. I had to do a lot of insisting to get agreement that the chairman of the soil committee should be someone actually working in the Pacific area. I consented to act as vice-chairman, if asked, only with the thought that the other scientists in Soil Survey work in the United States could make their contributions to the committee through my office.

Later, I have a brief conference with Mr. Archibald and others at which Mr. Holt suggests that the lands in the Pacific be classified by the so-called "use-capability method" of the Soil Conservation Service -- a method that he doesn't understand.

~~Feb~~ In the afternoon, Mr. N. H. Taylor gives a talk on the land to be seen on the tour from Auckland to Wellington. This is very interesting.

~~While~~ This evening my glasses come apart where they were repaired, so I shall need to get them looked after the first thing in the morning. Several who traveled light by air to the Congress will go to the reception tonight in "business" suits; but I shall not, since formal wear was asked for, (I don't know why). After dinner I retire early.

species went over the whole range, whereas some were found only in the arid soils and others only in the alkaline ones. Then, some fungi were found only in the surface horizons, whereas others were also in the deeper layers. Those with dry spores were largely in the surface; those with wet spores were found more deeply. Some of the antibiotics were confined to the upper layers, and their presence accounted for the absence of some fungi from the surface layers that are found in the lower horizons. He says that the soil contains a vast number of species. The ones most likely to be active depend upon what is added to the substrate -- that is, the organic matter from the vegetation.

Mr. E. S. Amos discusses the results of lysozyme studies at the Soil Fertility Station near Hamilton. His

February 8

It looks this morning as if the rain might be over. First, I go down to the city to get my glasses repaired, which takes a long wait. Too bad. I go back to the sessions at the University just as the paper on boron by Mr. Laird is being completed.

Mr. A. Burges of Sydney gives a paper on soil fungi and humus decomposition. In a study of a series of soils ranging from pH 8.5 down to pH 3.5, he found that some species went over the whole range, whereas some were found only in the acid soils and others only in the alkaline ones. Then, some fungi were found only in the surface horizons, whereas others were also in the deeper layers. Those with dry spores were largely in the surface; those with wet spores were found more deeply. Some of the antibiotics were confined to the upper layers, and their presence accounted for the absence of some fungi from the surface layers that are found in the lower horizons. He says that the soil contains a vast number of species. The ones most likely to be active depend upon what is added to the substrate -- that is, the organic matter from the vegetation.

Mr. H. E. Annett discusses the results of lysimeter studies at the Soil Fertility Station near Hamilton. His

results show a high loss of magnesium carbonate related, perhaps, to the high use of low-analysis superphosphate (18 - 22 percent) with much gypsum. He says there is growing evidence of magnesium deficiency. But the discussion brought out that the soils now used have probably had substantial applications of serpentine as well as of superphosphate.

F. B. Thompson and I. L. Elliott discuss the successful fertilization of peat soils near Hamilton for pasture with rye grass and clover. They are trying to develop the peat soils where they are associated with good upland soils. Both phosphorus and potash were used along with 5 lbs. of copper sulphate per acre per year.

I go to lunch and then pack for the tour to Wellington. The bus comes at 2:10 p.m. and we are off. First there is a large area of suburban land nearly to Papakura. Beyond, there are mostly small farms along the road. The many hedges remind one of England. Most of the soil is rolling to strongly rolling.

We pass Bombay. The pastures here are better than in North Auckland. The farming is older and more stable. The soil is better and is better cared for with mowing and similar practices. There are a few fruit and vegetable farms. The rainfall along here is about 50 inches.



K-1695 February 8, 1949
New Zealand. South of Bombay. Typical rural
landscape.

It is a pity there is no time even for pictures, let alone for the examination of soil profiles. Beyond Mercer, the country is hilly -- mudstone partly covered with Hamilton ash. On the steeper slopes, where grazed, there are some slips, but not nearly so many as in the North Auckland country on comparable slopes. But most of the steeper slopes are covered with scrub. It is said that dairy farms here average about 5 acres of crops for each 100 acres of grass. A simple inspection from my bus window doesn't even disclose the 5 acres. We are told that practically no concentrates are used. I do see a little thickly sown maize to be fed green. We cross the Waikato River a little ways north of Hamilton and enter Waipa County, which is said to have the highest average carrying capacity per acre of grass of any county in New Zealand. A farm survey was made covering all the farms in this county during 1946 and 1947. Of the total crop land (220,000 acres), 182,334 acres were in grass. There were 70,182 dairy cows, 49,156 other cattle, 188,469 breeding ewes, 159,480 lambs, and a total of 213,742 shorn sheep.

A special study was made of 850 dairy farms milking 20 cows or more. Butter fat per cow was 253 lbs., with 228 lbs. going to the factory. Butter fat per acre was 161 lbs., with

138 lbs. going to the factory. Butter fat per labor unit was 8,516 lbs., with 7,443 going to the factory. There were 60.3 cows in milk per 100 acres of grass, and an average of 32.5 cows per labor unit. These farms cut about 20 percent of their grass for hay or silage. They had about 3 percent of the area in root or forage crops -- about 5 acres per 100 cows. Seventy-five percent of the grass was top-dressed with phosphate and 46 percent with lime. The average capital value of land improvements was 74 pounds (roughly \$300) per cow or 3,267 pounds (roughly \$13,000) per 10,000 lbs. of butter fat delivered to the factory.

On 133 of these farms, sheep are run with the dairy cows; and on another 132, both sheep and beef cattle run with the dairy cows. Eighty-seven of these farms grow fat lambs, using South Down rams on Romney ewes. These farms carried 3.3 breeding ewes per acre of grass and fattened 3.2 lambs per acre, each about 110 lbs. dressed. In addition, they had about 8.4 lbs. of wool per sheep, or 32.7 lbs. of wool per acre. One labor unit was required for each 756 sheep.

It is said that in pre-European times, the Maoris dug out sand and spread it over the heavy soils in order to grow sweetpotatoes. They burned the scrub on the sand with a

slow fire, which greatly raised its phosphate content.

It is said that even now some of these Maori fields have 10 times the content of phosphate found in the surrounding land. I see several of the pits they used, which extend down into the sandy pumice beneath.

The higher-lying soils here are sandy loams; the lower-lying ones are silt loams and heavier. Thus, the combination gives good year-round grazing.

We reach Hamilton at 5:45 p.m. I change, have dinner, and than a little chit-chat with Professor Robinson, Norman Taylor, Director Kay, and the others before early to bed.

February 9

We are in the buses about 9:00 for a local field trip. First, we visit the local Frankton Branch of the New Zealand Cooperative Dairy Company, which is said to have an output of some 11,500,000 lbs. of butter annually. All the dairy factories are cooperatively owned and operated by the farmers. Milk is separated and cooled on the farms and collected daily by trucks. It is tested on arrival at the factory and payment is based upon butter fat and quality. The cream is flash pasteurized, cooled, and stored overnight. It is churned the following morning and packed in boxes or cartons.

A long time is spent in watching this ordinary process. Although there is a good deal of explanation, the machinery makes so much noise I can't hear it.

We then go out to the Rukukia Soil Fertility Station. First, of course, we must have tea! Just a waste of time.

I leave the party for a few minutes in order to get a look at the main soil here -- the Hamilton clay loam -- in a road cut. This soil is developed from an old ash shower. The land was originally forested, but is now almost wholly developed for dairying, with some sheep, except for a few



K-1696 February 9, 1949
New Zealand. Hamilton. Handling butter in
cooperative butter factory.



K-1697 February 9, 1949
New Zealand. Hamilton. Sheep in yards.

market gardens. Grass is very good except for the late summer and early autumn. Most of it is rolling.

A ₁ (p)	0-6"	Very dark gray, granular clay loam. The soil digs out in clods that are easily friable.
B ₂	6-18"	Dark reddish-brown (5YR 3/2) clay. Irregular medium nut. Friable with difficulty. The soil is fairly dry now and has large cracks so that it digs out in huge clods that fall into nut aggregates.
B ₃₀	18-28"	Transitional. Reddish-yellow (5YR 5/6) clay, with coarse nut structure.
B ₃₁	28-36"	Yellowish-red (5YR 4/6) clay, with angular, coarse nut structure. Aggregates have very thin, glossy coatings. Crushes only with extreme pressure.
B ₃₂	36-46"	Yellowish-red (5YR 5/8) clay, but not quite so heavy as above. Coarse, angular nut structure.
C	46-60"+	Reddish-yellow (5YR 6/8), mottled with lighter shades, fairly easily friable clay. This is old volcanic ash.

At irregular depths are older ash strata rich in mica and mottled gray and yellow in color. Also in the lower solum are some gray bands of kaolin about one-quarter to two inches thick.

This Hamilton clay loam is included with the "moderately leached brown granular clays." I should be inclined to consider it a Brown Forest soil tending toward the Gray-Brown Podzolic.



K-1698 February 9, 1949
New Zealand. Near Hamilton. Landscape on
Hamilton clay loam.



K-1699 February 9, 1949
New Zealand. Near Hamilton. Landscape on
Hamilton clay loam. (Another view)

In the lowlands associated with this soil is the Rotokauri peaty clay loam. Willow trees grow in the wetter parts. Some Chinese market gardeners use this soil and some have sprinkler systems for supplemental irrigation.

I hurry back to join the main party at the Station. After a quick look at the lysimeters, we are taken down to see an area of peat that is being reclaimed. The peat is some 25 feet deep. Due to subsidence at the margins, the area is undulating.

The surface is finely granular, mixed woody and fibrous peat. It is said to be quite acid, about pH 4. The material seems fairly well decomposed for such a low pH. It looks to me a bit like burned Rifle peat.

They use 2 tons of lime and a heavy application of phosphorus (about 10 cwt. per acre of serpentine superphosphate) and about $2\frac{1}{2}$ cwt. of potash fertilizer in order to get pastures with clover.

I notice that directly under the grass a thin, brown, tough turf or mor-like layer is developing. Likely this will need to be chopped up with a disc occasionally.

There is some question in my mind as to just how practicable it is to try to develop this soil. Our guides think that it will work out all right.



K-1700 February 9, 1949
New Zealand. Near Hamilton. Soil fertility
Experiment Station. Irrigated grass plots.



K-1701 February 9, 1949
New Zealand. Near Hamilton. Experimental
area on peat land.

We then return for lunch and afterward go to the Ruakura Animal Research Station. The soils are said to be Horotiu sandy loam and Te Kowhai sandy loam and loam on alluvial terraces of the same age as the Waikato fan. First, I take some photographs from a hill of Hamilton clay loam near the central part of the Station. Some of the lowland has been reclaimed from wet alluvials and peat.

The Station is divided into separate farm research enterprises, each under a professional worker with his own staff. Here they have laid a lot of emphasis upon research with identical twin calves. They have 170 pairs. They use them in study of sterility, improvement through breeding, feeding experiments, and so on. They also have experiments with sheep, beef cattle, and pigs. The pasture land is used about one-half for hay and one-half for silage.

It is said that the differences among soils are more noticeable during drought periods than in total yield of grass. I see some good pastures on long-drained, shallow peat that has been treated with lime, phosphate, and some potash. Copperized superphosphate is used. In certain seasons they have a little cobalt deficiency.

The piggery is very clean and well arranged. On warm days, like today, each sow's pen has a fine spray of cool water in which she can stand.



K-1702 February 9, 1949
New Zealand. Near Hamilton. View on Ruakura
Animal Research Station from hill on Hamilton
clay.



K-1703 February 9, 1949
New Zealand. Near Hamilton. View on Ruakura
Animal Research Station from hill of Hamilton clay.
(Another view)



K-1704 February 9, 1949
 New Zealand. Near Hamilton. Ruakura Animal
 Research Station. Identical twin dairy bulls
 differently fed.

Some of us go out to one of the pastures and look at the Te Kowhai silt loam. This is a practically level Gray Hydromorphic soil that has been tile drained. The grass is excellent.

A ₁₀ (p)	0-3"	Brown silt loam. Soft granular and irregular nut mixed.
A ₁₁	3-6"	Pale brown silt loam, mottled with light gray and reddish-brown. Fairly friable fine to medium angular nut.
G ₁	6-24"	White, mottled with dark reddish-brown and yellow, silty, clayey, very fine sandy loam. The soil is massive and digs out easily in friable clods. It is quite vesicular. There are a few incipient large banded concretions. (10YR 8/6)
G ₂ (C)	24-30"+	Light yellow (10YR 8/6), mottled with dark reddish-brown and yellow, silty clay. Massive, but digs out as fairly friable clods. The material appears to be reworked andesitic and rhyolitic ash.

Here the drain tile are 18 inches below the surface and about 66 feet apart. I am told that 10 cwt. of lime are used every third year (?) and 3 cwt. of superphosphate every year. Neither potash nor copper is used. One and one-third acres will carry a cow. Yield of butter fat is about 200 lbs. per acre.

We then examine the Horotiu sandy loam nearby on an old levee. It is very gently undulating and is now under grass.



K-1770 February 9, 1949
New Zealand. Ruakura Animal Research
Station. Profile of Gray Hydromorphic soil
(Te Kowhai silt loam).



K-1705 February 9, 1949
 New Zealand. Near Hamilton on Ruakura Animal
 Research Station. Filling the pit after examining Te
 Kowhai silt loam. L. to R.: G. W. Robinson, N. H.
 Taylor, J. K. Taylor, and H. Annett.



K-1706 February 9, 1949
 New Zealand. Near Hamilton. On Ruakura Animal
 Research Station. After examining Horotiu
 sandy loam. L. to R.: G. W. Robinson, H. Annett,
 N. H. Taylor (back), J. K. Taylor.

This also is developed from reworked andesitic and rhyolitic ash. The soil is well drained. In New Zealand it is included with the "yellow-brown loam." Likely I should have placed it as an immature Brown Forest.

- | | | |
|---------------------|---------|--|
| A ₁₀ (p) | 0-5" | Very dark brown to brown (7.5YR 4/4) light fine sandy loam. Softly granular. |
| A ₁₁ | 5-13" | Brown (10YR 5/3) light fine sandy loam. Single grain to soft crumb. The lower boundary is very sharp. |
| B | 13-26" | Brownish-yellow (10YR 6/8) sandy loam. There are many particles of unweathered minerals. Massive, but digs out very easily and is easily friable to fine crumb and single grain. Some brown staining from the roots. |
| C | 26-36"+ | Yellow, tinged with olive, loamy sand. Single grain. Many dark-colored grains. |

Lime and superphosphate are used on this soil and potash as well. Probably magnesium is also needed.

I take a hurried look at the dairy breeding and feeding experiments. We are back at the hotel at 5:40. After dinner, I excuse myself from an evening meeting at the Experiment Station, since I know it will be far too late and that we have another evening meeting tomorrow with the Maoris.

February 10

I am packed and ready for breakfast at 7:10. People are so slow in starting in New Zealand. Hamilton has been growing rapidly in recent years on account of the thriving dairy industry. Yet it has only 3 hotels. A law was passed several years ago that no new licenses for bars would be issued, on account of the anti-saloon sentiment. Some of the forest towns have gone down to very few inhabitants and still have many hotels. Apparently, if a man has a license, he won't give it up; nor will anyone start a new hotel without one.

We are finally away in the bus at 9:00, and pass over nearly level to gently undulating "yellow-brown loam" developed from deep fan material. Some of the soil is imperfectly drained. It is used for intensive dairying and sheep grazing. I see a few patches of thickly sown maize. There are many hedges along the roads and in the field boundaries. This area is said to have been long settled and formerly a lot of wheat was grown.^{1/} We are told that 92 percent of the cows here are milked with machines; in fact, in New Zealand, only 3 herds having more than 50 cows are milked by hand. Thus, electric power is very important. (Today is going to be hot. Even now I could enjoy some good American ice water.)

^{1/} This wheat was said to have been grown and milled into flour by the Maoris for export to California during the early days of the Gold Rush.

We stop to see the Karapiro Hydro -- a small dam on the Waikato River. This is supposed to have a capacity for 90,000 kilowatts. It is one of a chain of 10 stations, built, planned, or under construction, on the Waikato with a total potential of 800,000 kilowatts.

I see a few small fields of thickly sown maize and turnips. Then we are soon in strongly rolling land, mostly in pasture, but with more sheep than cows. There are many patches of scrub in the poorer places. All the soils here are developed from volcanic ash of one age or another, or from the alluvial products of the ash. Here the Tirau ash covers the Hamilton ash and the scrub is more common. This Tirau ash is a mixture of rhyolite and andesite, more acid than the Hamilton.

We stop for a moment and I get a picture just where the Waikato River left its old channel and now turns north into its new channel. We drive on into the Hinuera Valley, which was once occupied by the Waikato. Much of the land is strongly rolling to hilly. Near the base of the steep slopes are huge rhyolitic boulders. We gradually rise to the high volcanic plateau. We stop about 2 miles east of Tirau for a two-minute (!) look at the Tirau soil developed from the



K-1707 February 10, 1949
 New Zealand. 17 miles southeast of Hamilton.
 The Karapiro Hydro on the Waikato River.



K-1708 February 10, 1949
 New Zealand. 27 miles southeast of Hamilton.
 View of Waikato River looking over old blocking
 terrace, which turned it north into its present
 channel.

Tirau ash. The land is strongly rolling. This soil is included with the "yellow-brown loams."

A ₁ (p)	0-6"	Grayish-brown fine sandy loam. Softly granular.
B ₂	6-24"	Yellowish-brown (10YR 5/6) sandy loam. Massive in place, but easily friable to granular. Some slight cracking.
		Grades into:
B ₃	24-36"	Brownish-yellow sandy loam. Vesicular. Massive in place, but digs out easily into friable clods.
C	36-48"+	Similar to the above, but with less roots and very slightly more compact. Some banding of the colors. The soil contains many unweathered minerals and will become heavier in texture with age.

In this same place the contrasts of the more recent ash with the old are striking.

As we go on I see a small field of pampas grass for winter feed. Here, it seems to me, there are somewhat more hay stacks, probably because of a longer winter season.

We stop at Putaruru for tea. I am told that east of here much of the land was considered to be worthless prior to the discovery of cobalt deficiency.

After lunch we go into this area, mainly developed since the cobalt story was worked out. There are many new farms and others are being developed. The layer of Taupo pumice



K-1709 February 10, 1949
New Zealand. 2 miles west of Tirau. Contact
of recent ash (Tirau) and older ash.

ash gradually thickens as we go on. This pumice was erupted in recent times from craters in the floor of Lake Taupo. About 4 to 5 cubic miles of material were ejected to cover some 560,000 acres with 6 inches or more. Sheep and cattle on this land suffer "bush sickness" unless cobalt is used. This story was worked out about 1930. Between 1920 and 1930, around 250,000 acres were planted to Pinus radiata by private companies. Now this land can be used for pasture with an estimated average yield of 100 to 120 lbs. of butter fat per acre or around 2 to $2\frac{1}{2}$ ewes per acre. I am told that well-managed land will go up to 175 lbs. of butter fat to the acre.

Where we go along, most of the land is rolling to strongly rolling with sharp, complicated slopes. Between the knolls and ridges are some small undulating areas, part of which are imperfectly drained. There are only a few hedges here, and the country has a much more open aspect.

In many places, the rhyolitic rock is fairly near the surface. It outcrops near the base of some of the steep slopes. Generally, the pastures look good and the soil is well covered. There are very few slips or other evidences of soil erosion. In the road cuts the soils seem to be quite light colored, except for the very surface.

This region is higher than the Waikato Valley and not quite so productive because of the long feeding season.

There are somewhat more crops, including pampas grass, and about 20 percent of the pastures are used for hay.

About 2 miles beyond Tokoroa I take a sample of Taupo sandy silt, included with the "yellow-brown pumice soils." I should regard it as an immature Brown Forest. The surface is rolling and now has a heath-like vegetation. Originally there was said to be a scrub forest.

N. Z. Sample No. 5

- | | | |
|----------------|---------|---|
| A ₁ | 0-4½" | Dark grayish-brown fine sandy loam. Well matted with roots. Very softly and finely granular. (10YR 4/2 - dark grayish-brown) |
| A ₂ | 4½-14" | Very pale brown to yellow (10YR 7/4 - 7/6) fine sandy loam. Massive, but digs out easily into friable clods that go to soft granular. Slightly compact. (10YR 6/3 - pale brown) |
| A ₃ | 14-21" | Very pale brown, loose sandy loam. (10YR 7/3 - very pale brown) |
| C ₁ | 21-30" | Light grayish-brown, slightly mottled with yellow, sandy loam. Only slight compaction. (10YR 7/2 - light gray) |
| C ₂ | 30-35" | Loose, gray and brown mottled pumice, light sandy loam. (This is Tokaroa pumice -- cobalt deficient.) (Approx. 10YR 7/2 - light gray) |
| D | 35-48"± | Yellowish-brown sandy loam. Massive, but digs out into chunks that are easily friable to mellow crumb. (Older ash of the Tirau period.) (10YR 5/4 - yellowish-brown) |

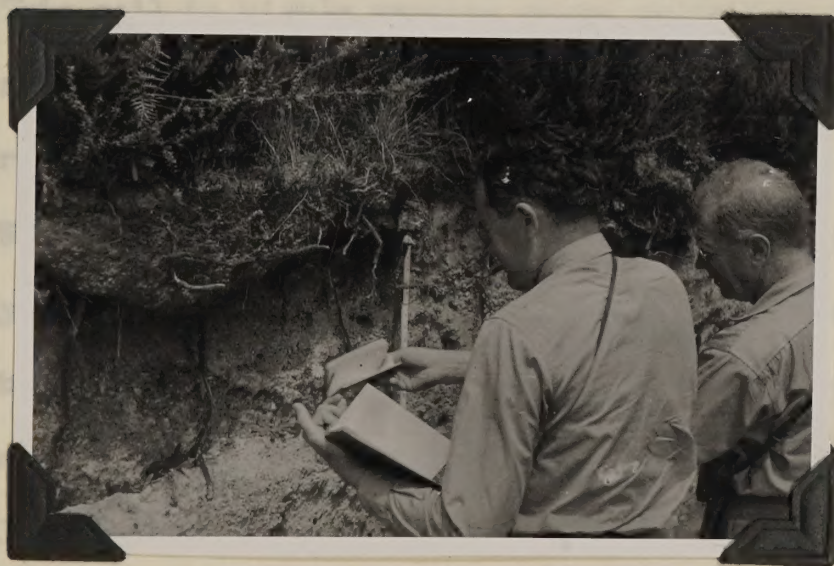
This region is higher than the Matto Valley and not quite so productive because of the long feeding season. There are somewhat more crops, including pampas grass, and about 20 percent of the pastures are used for hay. About 2 miles beyond Tokoro I take a sample of "sandy soil", included with the "yellow-brown pumice soils." I should regard it as an immature brown forest. The surface is rolling and now has a heath-like vegetation. Originally there was said to be a scrub forest.

N. E. Sample No. 5

Dark grayish-brown fine sandy loam. Well matted with roots. Very soft and finely granular. (JOYR 1/2 - dark grayish-brown)	0-1 1/2"	A1
Very pale brown to yellow (JOYR 1/4 - 1/2) fine sandy loam. Massive, but digs out easily into friable clods that go to soft granular. Slightly compact. (JOYR 1/2 - pale brown)	1 1/2 - 1 3/4"	A2
Very pale brown, loose sandy loam. (JOYR 1/2 - very pale brown)	1 3/4 - 2 1/4"	A3
Light grayish-brown, slightly mottled with yellow, sandy loam. Only slight compaction. (JOYR 1/2 - light gray)	2 1/4 - 3 1/4"	C1
Loose, gray and brown mottled pumice. Light sandy loam. (This is Tokoro pumice -- cobalt deliquescent.) (Approx. JOYR 1/2 - light gray)	3 1/4 - 3 3/4"	C2
Yellowish-brown sandy loam. Massive, but digs out into clumps that are easily friable to yellow crumb. (Older ash of the Tama period.) (JOYR 1/2 - yellowish-brown)	3 3/4 - 4 1/4"	D



Examining soil profile (Kellogg).



Examining soil profile (Kellogg and Robinson).

The material is high in silt and might be called a silty sand. There is a high content of clay-forming minerals of sand and silt size. The soil has an unusually high water-holding capacity for its texture. Even the coarser particles are filled with tiny holes. Everybody is in a terrible hurry and scolds me for the few minutes I take to describe this soil.

We drive on into hilly country having this same soil, with planted forest, mostly radiata except for ponderosa in the frosty lowlands. These trees look fairly good, but not too vigorous. If diseases or insects ever got started, they would certainly run through such pure stands in a hurry.

This soil is highly erosive where exposed in deep road cuts and the water is concentrated. It resembles loess in this respect and also in the nearly vertical road cuts.

We come into the Mangakino Land Development Area on gently rolling soil from the Tirau ash. We pass meadows with beautiful red clover, just now used for fattening beef cattle, that were developed from the scrub since 1946 -- from land formerly considered to be worthless.

Our bus gets stuck in the pumice ash on a new grade. I believe these are the dustiest soils I have ever seen.

I am told that 900 acres were sown in the autumn of 1947, 260 in the spring of 1947, and 1200 in the autumn of 1948. They hope to do 900 more by the autumn of 1949. The scrub is crushed with a 5-ton roller, burned, and plowed with a disc. (Here it is mostly manuka shrub.) The fertilizer is then added and the seed, and the land cultivated with a brush harrow. The seed is sown with 3 cwt. of superphosphate (44 - 46 percent) in the autumn and top-dressed with a further 3 cwt. (336 lbs.) in the spring. Then 3 cwt. are used again in the autumn, to give a total of 9 cwt. for the initial treatment. After that, 3 cwt. are used annually. In the first 3 applications, cobaltic superphosphate is used. This is made by adding 6 lbs. of cobalt sulphate to one ton of superphosphate. Usually in an application, one cwt. of this is used along with 2 cwt. of ordinary superphosphate. One pound of cobalt sulphate to the acre will last about 4 or 5 years, but it is recommended that 4 or 5 ounces be used annually with the superphosphate.

The land is seeded rather heavily -- at the rate of 45 lbs. to the acre, made up as follows: perennial rye, 25 lbs.; cocksfoot, 8 lbs.; timothy $1\frac{1}{2}$ lbs.; crested dogstail, $1\frac{1}{2}$ lbs.; and 3 lbs. each of white clover, broad red

clover, and subterranean clover. The red clover comes up strongly the first year. This is usually undergrazed with beef cattle brought in from the outside. They tramp in a good deal of it and this helps to consolidate the surface.

The rainfall here is around 60 inches and fairly well distributed. They estimate an average carrying capacity of 38 to 40 cows per hundred acres (100 to 120 lbs. of butter fat per acre) or 2 to $2\frac{1}{2}$ ewes per acre. The area is being subdivided into 130-acre farms for returned veterans.

There is an estimated potential for this kind of development of 227,000 acres. There are 3,200 acres in this initial development that we see, and this will be extended.

The application of these methods depended upon a very careful soil survey, because not all of the soils can be treated successfully in this same way.^{7*/} Some areas of this ash, too, received a shower of mud from a more recent eruption (1886) and do not require cobalt treatment where the covering was 2 inches or more.

I try to take some pictures of the pastures here where the development is for the veterans. We look across the road to another development scheme of similar nature for the Maoris.



K-1710 February 10, 1949
New Zealand. Near Mangakino. Land Development
Scheme. Lands being prepared for grass seedings.



K-1711 February 10, 1949
New Zealand. Near Mangakino. Land Development
Scheme. Lands being prepared for grass seedings.
(Another view)



K-1771 February 10, 1949
New Zealand. Near Mangakino. Land Development Scheme. Land being prepared from scrub.



K-1772 February 10, 1949
New Zealand. Near Mangakino. Land Development Scheme. Cattle grazing on the initial pasture, dominantly red clover, this year.



K-1712 February 10, 1949
New Zealand. Near Mangakino. Looking over
recently developed land to construction camp for
a Hydro on the Waikato River.



K-1713 February 10, 1949
New Zealand. Near Mangakino. Fresh road cut,
showing charcoal where hot pumice ash came on
the original forest.

It is thought that the forest worked a little way into this recent pumice area. Of course, the hot pumice killed all the original forest and buried it (see photo). Road cuts show a great variation in the depth of the pumice. It likely fell on uneven ground and has since been reworked by both wind and water.

It is truly remarkable what has been done here -- this change from scrub to good mixed pastures.

We return for a way over the same road and again cross the Waikato River where it flows through a crack in the rhyolite. Ordinarily it is about 20 feet deep and 80 feet wide; here it is 20 feet wide and 78 feet deep and flowing at the rate of about 5,000 cubic feet per second. We then go up the river into steep and stony pumice land covered with scrub. Many poisonous plants are said to grow here.^{1/} A little way further we come to rolling land used for pasture. There are some narrow terraces and wet places along the river with patches of New Zealand hemp.

After a little way, the road is better and we pass 20-year old plantings of pine (radiata). We stop for a few moments to look at the soil under this pine, and I take a sample of the A₁ as Special Sample No. 5A. (The soil here is an incipient Podzol.)

^{1/} Poisonous plants are Tutu, Strathmore weed, and Ragwort. They are common in many parts of New Zealand.



K-1714 February 10, 1949
New Zealand. Near Mangakino. Waikato
River here flows 5,000 cubic feet per second
through a crack in the rocks 20 feet wide
and 80 feet deep.



K-1715 February 10, 1949
 New Zealand. About 25 miles south of Rotorua.
 View of floor in pine (Radiata) planting 20
 years old.

A ₀₀	2-1"	Brown fallen leaves.
A ₀	1-0"	Light brown decomposed needles.
A ₁	0-3" (2-6")	Light gray and brown, grossly mottled, fluffy, very fine sandy loam. Exceedingly low volume weight. (10YR 4/1 to 5/1 - gray to dark gray)
A ₂	6"-	Very pale brown fluffy soil from fine pumice ash.

It is said that good Podzols exist on this same ash under the native forest.

We pass the Guthrie Settlement, developed immediately after World War I, on which grass is laid down with phosphate fertilization. Then we pass some nice dairy farms which were started about 1930. Most of the land is quite rolling, with patches of steep scrub land. Some beef cattle are grown here as well as dairy cows and many sheep.

Here one feels that New Zealand is a pleasant country.

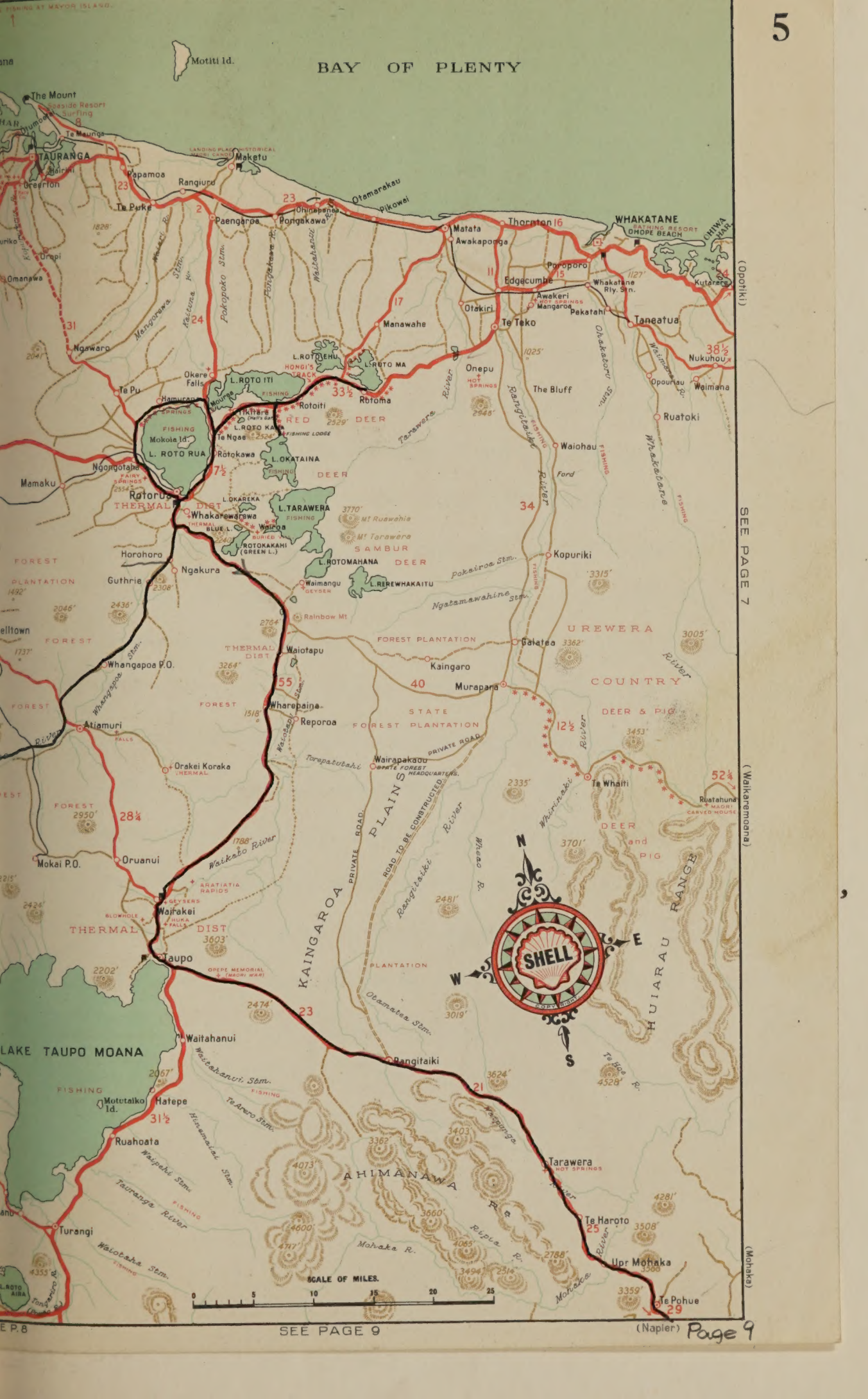
We arrive at the Geyser Hotel in Whakarewarewa, Rotorua, at 5:30 p.m. Immediately after dinner we go to a Maori meeting house -- the Taiporutu Club -- for a concert. This is a rather elaborate, small building with rich carvings in the front that are painted a dark pinkish-red. The totem poles and various figures adorn the top. First we are seated on benches out in front of the entrance. Near us are some small thermal steamers. Later we are brought inside. The



K-1722 February 11, 1949
New Zealand. Rotorua. Taiporutu clubhouse of the
Maoris.



K-1721 February 11, 1949
New Zealand. Rotorua. Taiporutu clubhouse of the
Maoris. (Another view)





REFERENCE.

SCALE: 1 inch = 11 $\frac{3}{4}$ miles.

MAIN ROAD:	- - -		
SECONDARY ROAD:	Bitumen or metal surface		
	Formed, not metalled	- - - - -	- - - - -
FOOT TRACK:		SCENIC ROAD:	
MILEAGE:	Red figures show distance between dotted towns	- - -	
	or to obvious junctions	- - -	
RAILWAY LINE:	- - -		
MOTOR CAMP:	- - -		

interior is gaily decorated. Women, mostly girls, but some middle-aged women, and young men dance. The people are not nearly so oval-faced as the Hawaiians. Very few of the women could be called really pretty, and some of them miss it by a great deal. Men have short "shorts" and grass skirts only. The girls have bodices with colored geometric patterns and red skirts with fibre hanging over them. Small fibre balls hang from the belt. They wear necklaces with single charms, some small and some large. Each has a small feather on a long spine of some sort in the hair that sticks up vertically. Some have short hair, a little below the ears, and some have long hair. They vary in skin color from dark brown to white. Not many are very dark, and I judge that only a few are full-blooded Maoris. Two of the older women have their chins painted. After a short opening dance, there is a welcoming speech by the local Chief in the Maori language, which is translated sentence by sentence into English -- a very slow process. This is followed by a sort of chant. Then there is a welcoming speech from the Mayor of Rotorua. This is followed by another and gayer chant with some solo parts and a little dance done mostly with the hands. As it goes on, the chorus gets louder.

Then Mr. Harper, Under-Secretary of Internal Affairs for New Zealand, makes a somewhat stuffy speech in which he says all the things that he says "I don't need to say."

Sir Peter Buck, perhaps the most distinguished Maori, now in charge of the Bishop Museum in Honolulu, speaks at some length. He says the Maoris are now becoming adjusted to the new situation. He gives quite an emotional plea for Maori culture and for the future Maori culture in New Zealand. I doubt if he is taken seriously and doubt if he really should be. He is introduced as "an exceedingly modest man." Although undoubtedly very able, this expression should never have occurred to me for application to Sir Peter.

Then there is another dance and chant. This one is undoubtedly pagan and tropical in origin, but a considerable stage above the dances of the Central African blacks.

Dr. Ryerson of the United States gives a "pretty" speech. And so does the Governor General of South Australia. This last one is very stuffy.

The Maori chorus plays a kind of game with sticks. Pairs of girls sit face to face, each with a pair of sticks. While the chorus sings, the girls toss the sticks to one another in different ways. In one group of 4, the 2 pairs mix their

throwing. The girls are not especially skillful. Next, a man and girl face each other to do a dance and chant in which the whole chorus later joins. The idea is obscure to me.

This is followed by another song and dance that seems to take a lot of hand work. This is quite good, but still a long ways from the Roxyettes. Then another.

Next, girls seat themselves in two rows as in a canoe. Their hand movements suggest rowing. Along with this are solos and the chorus. Each of the girls whirls rapidly two little balls on a short string. Undoubtedly this suggests the coming of the Maoris to New Zealand. There are two movements: the first is traditional and pagan, while the second is more modern -- even has a piano accompaniment!

Then we have the haka dance and chant by a group of older (and rather heavy) women and men of middle age. This is another song and dance with a lot of hand work. It is very popular with the audience, but seems to me a bit rough as well as quite primitive.

Next is a classical Maori poem, a chant with a little dancing and much hand work. This is followed by another song and a slow chorus.

Then a women's chorus sings and the dancers whirl and bounce their little fibre balls over their hands. They follow this with a gay one. Then there is a combined female and male chorus with lots of hand work.

Now comes another male chorus and dance, very vigorous and quite primitive.

The girls sing a chorus while they work their hands and throw the gay fibre balls on long strings. This is followed by another gay and primitive girl chorus. We approach the end and have a chorus of farewell to the men who went to the 1914 - 1918 war. For the last chorus at 10:45, all are seated.

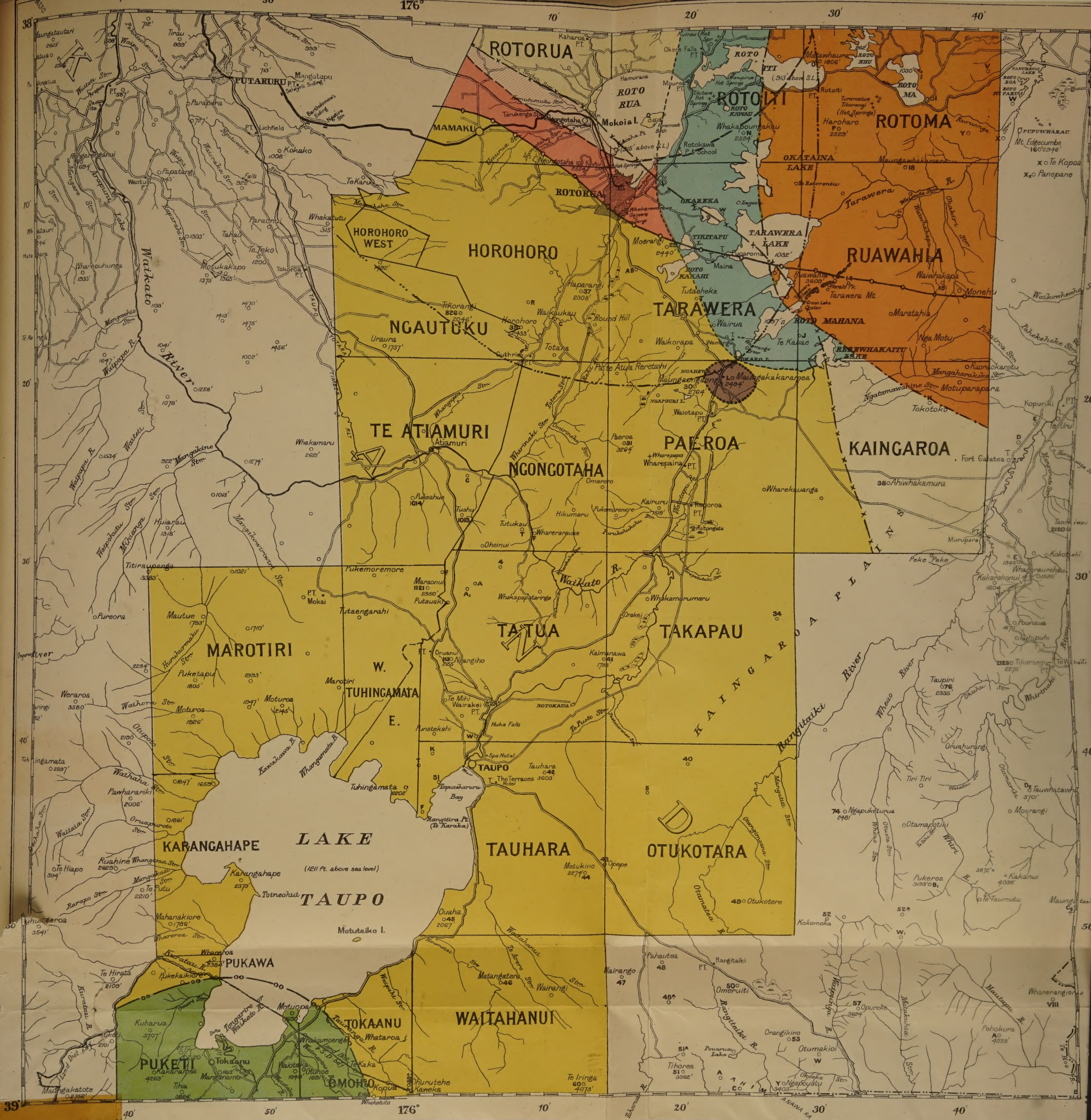
We then go to another building for refreshments and more entertainment with another chorus consisting of a few men but several girls.

Like other primitive choruses, they sing and dance together, but when any individual dancer feels like doing something special, he or she goes ahead with it.

We are finally back to our hotel at midnight after a long day.



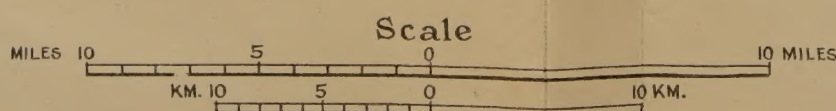
This map shows the approximate areas affected by the material ejected in the various volcanic outbursts which have occurred in past ages. Though the nature of this material has profoundly affected the character of the soils whereon they occur, the presence of any particular volcanic deposit does not necessarily determine whether these soils are healthy or otherwise, so far as stock are concerned. Contour, climate, the influence of river action, water sorting, subsoils, and forest growth have so modified the character of the soils in particular areas that great care must be taken in making generalizations from an inspection of the map. The proper use of the map is to give indications only, and the actual effect of the volcanic showers can only be interpreted by detailed examination of specific areas. In other words, it must not be assumed that, because a farm happens to be situated on a shower which is characterized by the presence of bush sickness, the soil on this farm must necessarily also be bush-sick.



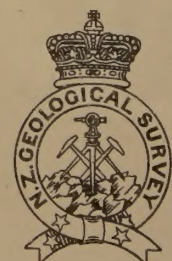
LEGEND

- * Ngauruhoe andesite ash and scoria
- Rotomahana mud
- Tarawera basalt scoria and ash
- Kakaramaea thermally altered acid andesite ash
- Kaharoa pumiceous rhyolite
- Taupo pumice
- Rotokawau basalt ash and scoria
- Mamaku and Rotorua rhyolite pumice

MAP SHOWING VOLCANIC SHOWERS EXPOSED AT SURFACE



* These boundaries delimit the deposits, and thus show the amount of underlie of those older than Tarawera and Rotomahana.



J. HENDERSON
DIRECTOR.

Topography by Lands and Survey Dept.

REFER TO INSERT

1. Automobile Association and N.M.U. Agent
2. Post Office
3. Government Grounds
4. Railway Station
5. Municipal Motor Camp
- 6.
7. Arikikapakapa Golf Links
8. Racecourse
9. Kuirau Reserve

REFER TO MAIN MAP

10. Ideal Motor Camp
11. Lakeside and Cottage Motor Camps
12. Koutu Motor Camp
13. Rainbow Springs Motor Camp
14. Rehutai Motor Camp

NOTE.—The numbers above (1 to 14) refer only to the small RED numbers on the FACE of the Locality Plan.
The white figures in blue squares refer to descriptive information on the BACK of the map.

ROTORUA

THERMAL WONDERLAND



Rotorua's Wonderland

For location of motor types and tourist resorts described hereunder, refer to corresponding numbers on face of map.

(11 m. from Rotorua P.O.)

Whakarewarewa, a thermal area of Whakarewarewa, known as "Whaka," lies adjacent to the Taupo district of the borough, 11 miles from the town. The many unique and weird sights and features are noted for their walks, bowers, beauty, and restful atmosphere.

Admission Charges: Adults, 1/-; Children under 12, 6d. Guide free.

7. MOKOIA ISLAND. Mokoia Island, a lone sentinel in the middle of Lake Rotorua, was once a fortified Maori stronghold and was a scene of much slaughter when Hongi Hika (refer No. 12) attacked the pa. A very interesting and touching Maori legend concerning the love of a Maori maiden, Hinemoa, centres on Mokoia Island. A warm bath of natural rock formation on the island bears her name. (Refer to "Legends" on other side of map.)

8. HAMURANA SPRING & ROUND THE LAKE. The Hamurana Spring is situated 10 1/2 miles from Rotorua on the northern shore of Lake Rotorua. Access is via Ngongotaha or Moutera.

10. TIKITERE. The thermal region of Tikitere, so aptly named "Hell's Gate," is noted more for its weirdness rather than for any natural beauty. The area is an inferno of boiling mud pools of different colours and varying temperatures, and is the most extensive of its sort in the Dominion.

Of particular interest are the remains of an old forest with the roots of huge trees in various stages of petrification. Some of these are the roots of the "hinahu," used in the colouring of the pin pin (native flax skirt).

According to tradition, the name Tikitere is derived from a particularly sad, yet romantic episode in the history of a "hapu" or sub-tribe of the Arawa people who lived in the district. A lovely maiden of high rank named Huritini, was given by her people to be one of the many warriors of a renowned warrior, also of rangitira rank, as a reward for his great efforts in battle against neighbouring tribes. Huritini conceived the idea that In Maori eyes this was an insult and a reproach to her people as well as to herself, and one night she put an end to her unhappiness by jumping into one of the boiling pools, now called Huritini in her memory. When her act was discovered it was exclaimed "Taku tiki e tere nei."

Literally translated, "Alas, our beloved tiki is here no longer." The commemoration of this sad incident has clung to the locality, and has been abbreviated to Tikitere.

14. WAIMANGU AND LAKE ROTOMAHANA. The road to Lake Okereka turns off near the Blue Lake for the Government Round Trip. (Refer No. 14.)

15. WAIOTAPU. The thermal area at Waiotapu provides an interest hour's entertainment on the route between Rotorua and Taupo. The thermal region is on a loop-road and is reached by a A.A. sign, the attractions including a large lake, a hot spring, a champagne pool, the Fry Pan, Echo Lake, and the Chrysomelid Trenches. Adjacent to the thermal sights are the Venus and Spout Baths. Waiotapu guide fees: Adults, 2/6; Children, 1/-. The fee to the Lady Knox Geysers is 1/- extra. (Geysers play daily, approximately 10 a.m.)

16. OKAREI KOKAKO. (For location refer A.A. Motor Touring Map.) Okarek Koroia is an interesting thermal area, situated on the Waikato River 10 miles from Otiamuri.

The major thermal activities are on the far side of the river, across which visitors are conveyed by pontoons. Of particular interest are a steamy pool of water, terraces under formation, and a huge cavern the bottom of which is an alum pool and off which is a scalding sulphur cave, the inside of which is reminiscent of a Turkish bath. There is a two hours' sightseeing drive of the lake, or 2/- children, or 1/- adults, which are payable at the entrance, overlooking the river, including ferrying across the river.

17. ATAHU CANYON. Access to this scenic locality turns off the Auckland Highway at the junction of the Waikato River. It is 1/2 mile to the Canyon, through which flows a trail of the Waikato River.

The Canyon is less than 500 yds. wide, with sheer rock walls covered with hanging moss and miniature native ferns. Visitors can proceed dry foot through the Canyon on well-constructed duckwalks.

Enquire at house 3/2 mile off main highway. Admission: Adults, 1/-; Children, 6d.

18. TANIWA SPRINGS. Situated between Ngongotaha and Hamurana, six miles from Rotorua P.O. (17 m. from Rotorua P.O.)

19. GOLDEN SPRINGS. Situated 27 miles from Rotorua on Taupo Highway. Admission, 1/-.

20. VALLEY SPRINGS. (6 1/2 miles from Rotorua P.O.)

21. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

22. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

23. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

24. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

25. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

26. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

27. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

28. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

29. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

30. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

31. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

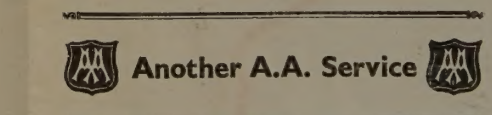
32. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

33. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

34. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

35. NGONGOTAHA. (Summit, 7 1/2 m. from Rotorua P.O.)

THIS map-leaflet is designed to promote a more general knowledge of the intensely interesting areas and the many beautiful scenic drives in the Rotorua Thermal area.



For particulars regarding Hotels and Camping Accommodation refer to the current issue of the "Automobile Association Handbook."

Under license from the Lands & Survey Department this map-leaflet is reserved exclusively for the use of Automobile Association members.

Published by THE AUTOMOBILE ASSOCIATION (Auckland) Incorporated NEW ZEALAND

Trout Fishing Regulations

RESERVED AREAS. The lakes and streams in the district provide some of the world's finest fishing waters, and areas are specially reserved for fly fishing. It is advisable to obtain a copy of the trout fishing regulations from the Internal Affairs Department Office in the Government Grounds at Rotorua.

DURATION OF SEASON. The fishing season opens on November 1 and closes on May 14.

HOURS OF FISHING. Fishing for trout is permitted only between the hours of 5 a.m. and 11 p.m.

LIMIT OF BAG. No person shall on any one day take or kill more than 10 trout. (Subject to probable amendment 1949 season.)

SIZE OF TROUT WHICH MAY BE TAKEN. No person shall take or kill in any manner or have in his possession any trout which does not exceed 14ins. in length from nose to tip of tail.

SALE OF TROUT PROHIBITED. No person shall buy, sell, expose or offer for sale, any trout, or fish for, take, or kill for the purpose of obtaining for sale, any trout.

LICENSES. No person may fish for trout unless he has first obtained an appropriate license. No license shall be transferable or be deemed to authorise any person to fish other than the person named therein. No license shall confer any right of entry upon the land of any person without his consent.

The license fees are as under:—

Class of persons to whom License is issued.	Whole Season.	Weekly License.	Day License.
	£ s. d.	s. d.	s. d.
Male person sixteen years of age and over	1 5 0	10 0	3 6
Women and persons under sixteen years of age	0 10 0	5 0	3 6

BOATS FOR HIRE. Launches, outboard motor boats, or rowing boats, may be hired for a moderate sum per day or half-day.

THE ABOVE INFORMATION IS SUBJECT TO ALTERATION PURSUANT TO ANY AMENDMENT OF THE TROUT FISHING REGULATIONS.

WARNING—FIRE! IT IS ILLEGAL TO LIGHT A FIRE ON, OR TO DAMAGE OR MUTILATE TREES OR PROPERTY IN ANY OF THE MANY SCENIC RESERVES IN THE ROTORUA DISTRICT. THE SAME RESTRICTIONS APPLY TO THE GOVERNMENT AFFORESTATION RESERVATIONS. THE NATURAL CHARM OF NEW ZEALAND IS GREATLY ENHANCED BY THE BEAUTY OF ITS NATIVE BUSH, AND THE AUTOMOBILE ASSOCIATION (AUCKLAND) ASKS THE CO-OPERATION OF EVERY MEMBER IN THE PRESERVATION OF THE GIFTS WHICH NATURE HAS BESTOWED IN SUCH PROFUSION.

LEGENDS

IRANGAITUKU AND HATUPATU. (Reference No. 1). In ancient Maori mythology the bush was peopled Patu-paearehe (supernatural beings), one of whom urangaituku), was a giantess who speared pigeons and kas (parrots) with her extremely long finger nails and beak-like lips. Kurangaituku was known as the d-woman and her domain was the vast forest of rakamaru, westward of Atiamuri.

One day when hunting pigeons a spear entered her s, and looking round she perceived some Maoris on a d-hunting expedition. These natives were Hatupatu d his brothers from Mokoia Island on Lake Rotorua. her cave home Kurangaituku kept a number of birds a huge aviary, which she tended with great care, and ver having seen a man she captured Hatupatu to be pt with her birds as a mokai (pet). Although Hatutu was treated with great kindness he was naturally xious to return home, and one day during Kurangai-ku's absence he crept away, as he thought, unobserved, aling up the hole through which he had crawled so that ne of the birds could escape to warn their mistress. iewer, the Riro riro, the smallest native bird, managed squeeze through a tiny opening and flew into the bush, lling to Kurangaituku "riro riro" (gone, gone).

Kurangaituku immediately set off in pursuit and exhausted Hatupatu as he was approaching a large rock ar Atiamuri. As a compensation for his disadvantage being born a third son, Hatupatu's grandmother had stowed on him supernatural powers, and now in his tremity he pronounced the potent spell "Matiti matata" pen and cleave asunder). The rock at once opened and ceived him, protecting him from Kurangaituku.

This rock, which is indicated by an A.A. sign on the taruru-Taupo highway, near Atiamuri, is known as Te Kohatu o Hatupatu" (the rock refuge of Hatupatu).

On Kurangaituku's departure Hatupatu continued his meward journey, but tiring, he rested on a rock at karaka and fell asleep, to be awakened by a rush of ind heralding Kurangaituku's approach. Once more by s magic power he escaped through a hole in the ground.

In the Hemo Gorge, approaching Whakarewarewa, ain closely followed by his pursuer, he ran across the eacherous ground familiar to him but unknown to urangaituku, with the result that she was engulfed while escaped. Thus ended the reign of the Bird Woman.

The claw marks made by Kurangaituku as she grabbed Hatupatu, are still visible on the rock at Pakaraka, ght miles from Rotorua on the Taupo Road.

INEMOA AND TUTANEKAI. (Reference No. 7.) Hinemoa was a young and beautiful Maori maiden, e only child of an important chieftain of the Ngati hakaue, who lived at Owahata (now known as Hinemoa's int), on the shores of Lake Rotorua.

Hinemoa met and fell in love with the athletic and ndsome Tutaneikai, one of the younger sons of the iefain of Mokoia Island. As a younger son, Tutaneikai as not the equal in rank to Hinemoa, and therefore her as and people forbade the marriage. Hinemoa was esely watched and her movements restricted, so that entually she decided to run away to her lover. One ght she crept down to the beach, intending to take a noe to paddle to the island, but to her dismay she found at her father, suspecting her intentions, had placed a iard over the canoes. Nothing daunted she obtained o calabashes, with the help of which as floats she swam her lover on Mokoia Island.

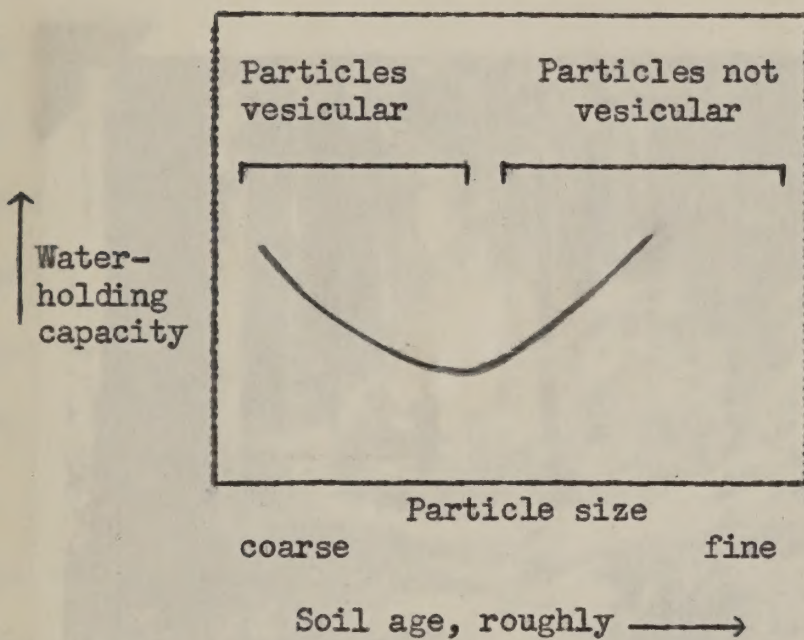
Tutaneikai was an accomplished flute player, and in e evenings he would send his love across the waters of e lake in sweet music, so that on this night unknowingly e guided her to safety. Reaching Mokoia Island, Hine-oa, trembling with cold and fatigue, crept into a natural ineral hot spring (now named after her), and while isting there saw Tiki, Tutaneikai's best friend, obtaining ld water from an adjacent spring. Concealing her face inemoa begged for a drink, after which she deliberately nashed the calabash. Tiki returned home for another labash, which Hinemoa again smashed when assuming a drink. Upon the incident happening a third time Tiki turned and informed Tutaneikai that an unknown person as deliberately insulting him. In a rage Tutaneikai

February 11

This is a bright, sunny morning that could easily turn into a hot day. We get into the bus at 9:00 and go to the Whakarewarewa State Forest. We see plantings of redwood (Sequoia sempervirens) and larch made in 1901 and 1902. It is said that redwood only grows well in a few odd spots like this. The timber is of poor quality. We see some nice Douglas fir about 44 years old. This is regarded as an excellent species for New Zealand. It grows well and gives high-quality timber. We see places where Pinus radiata was felled about 4 to 8 years ago with excellent regeneration.

All of this area has rather deep pumice of fairly recent showers. There is an interesting relationship here between the water-holding capacity of the soil and particle size. The original pumice is vesicular. Thus, the young, poorly weathered material of coarse size has a relatively high water-holding capacity because the grains are full of tiny pores. As the particle size goes down, so does the water-holding capacity, because with the smaller particle size there has been more weathering and less of the particles are porous. Then with still finer particle size, the water-holding capacity goes up again, as it would in normal soils. 8*/

In soils from pumice



We then go back to Rotorua for tea.

We then go northeast of Rotorua along the margin of the lake on a broad plain of undulating hill tops planted of the 1886 and 1890. Since this was the first in result, the animals are free of "bush sickness." Here there are some beef cattle as well as dairy cows. The lower the soils are



K-1716 February 11, 1949

New Zealand. State Forest near Rotorua. Redwoods and larch planted in 1901-02. (Mr. Kay)

Most of the land here is used by Maori farmers.

In only a few places are there undulating lands bordering the lake. About midway along the north side of Lake Rotiti,

We then go back to Rotorua for tea.

We then go northeast of Rotorua along the margin of the lake on a broad plain of undulating soil from pumice of the 1886 mud shower. Since this mud is rich in cobalt, the animals are free of "bush sickness." Here there are some beef cattle as well as dairy cows. In summer the soils are rather droughty, but they carry about 1 cow for 2 acres and produce about 150 lbs. of butter fat to the acre. Two and a half to three ewes may be carried to the acre. Although lime is not needed, phosphate is essential. There are small, imperfectly drained areas with dark grayish-brown surface soils.

We pass a small thermal area called Tikitere, where the land is rolling. In road cuts, one may see 4 and sometimes 5 layers, indicating separate showers of ash or mud. Many of these originated with an explosion under one of the lakes. Several years ago a shower of mud killed many people.^{9*} They were crushed in buildings. In some places the mud was 5 feet deep. I am told that a serious explosion may come at any moment, including today.

Most of the land here is used by Maori farmers.

In only a few places are there undulating lands bordering the lake. About midway along the south side of Lake Rotoiti,

We then go back to Kotorua for tea.

We then go northeast of Kotorua along the margin of the lake on a broad plain of undulating soil from ponds of the 1886 mud shower. Since this mud is rich in cobalt, the animals are free of "rush sickness." Here there are some beef cattle as well as dairy cows. In summer the soils are rather droughty, but they carry about 1 cow for 2 acres and produce about 150 lbs. of butter fat to the acre. Two and a half to three ewes may be carried to the acre. Although lime is not needed, phosphate is essential. There are small, imperfectly drained areas with dark grayish-brown surface soils.

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Most of the land here is used by Maori farmers. In only a few places are there undulating lands bordering the lake. About midway along the south side of Lake Kotorua.



K-1717 February 11, 1949
New Zealand. North of Rotorua. View over forest
with dairy country in background. Radiata repro-
duction following cutting.



K-1718 February 11, 1949
New Zealand. Nine miles northeast of Rotorua.
Dairying on young soil from ash.

we turn sharply south toward Lake Okataina. This road takes us through a native forest reserve that was badly damaged in 1886 by hot mud showers. Some of the injured trees still stand, along with one-half dead snags. We see little lakes that were explosion craters. I photograph one of these -- Mirror Lake -- with tropical rain forest, tree ferns, and "Spanish moss." Many trees have survived the showers of ash, and the forest is quite beautiful in places.

We have lunch at Fishing Lodge on the shore of Lake Okataina. I get a chance to look hurriedly at the soil under the rain forest.

There are big trees, some partly killed by the hot ash, and a heavy second growth, yet not so dense as most tropical rain forests. There are many tree ferns. The land is hilly and the slope here is 7 to 10 percent. The upper part of the profile is from the Rotomahana mud dropped in 1886. Beneath this (C) is the Tarawera basaltic ash, and this is underlain by (D) Kaharoa pumiceous rhyolitic ash (probably).

N. Z. Sample No. 6

A₀₀

Thin

A₀

2-0"

Brown mat of fairly well decomposed organic matter and live roots.

- A₂ 0-1" Very dark, dark brownish-gray loam, mottled sparsely with very dark brown. Shiny, but easily friable. (Mainly 1975 2/7 - dark grayish-brown)
- A₃ 1-3" Dark gray sandy loam, faintly mottled with yellow. Slightly compact. This is dotted with dark brown along the root channels. Shiny, but easily friable. (1975 2/1 - gray)
- C₁ 3-7" Dark gray and pale brown ordinary soil.



K-1719 February 11, 1949
New Zealand. View from Lake Okataina. (Looking toward sample No. 6)

A ₁	0-1"	Very thin dark brownish-gray loam, mottled grossly with very dark brown. Massive, but easily friable. (Mainly 10YR 4/2 - dark grayish-brown)
A ₃	1-3"	Dark gray sandy loam, faintly streaked with yellow. Slightly compact. This is mottled with dark brown along the root channels. Massive, but easily friable. (10YR 6/1 - gray)
C ₁	3-7"	Dark gray and pale brown cindery ash.
D	7-12"+	Pale brown, loose, somewhat cindery pumice ash.

We return by the same road to Lake Rotoiti and Lake Rotorua, and then north along the road that passes close to the north shore and down the west side of Lake Rotorua.

The only bad feature of this area to me is the terrible dust from the roads. It is rich in very fine silica particles and is most irritating indeed. In dry weather like this, any car stirs up a great cloud of this nearly white pumice dust.

We pass Mourea. The flats along the Ohau channel have a high carrying capacity for sheep. On the north side of the lake we get an excellent view of Mokoia Island.

On the west side we stop at Fairy Spring — a large pool bubbling of very clear water, with springs/beiling at the bottom, densely populated with rainbow trout. These trout will eat bread out of one's hand. It is amazing to see them so tame.



K-1720 February 11, 1949
New Zealand. North of Rotorua. View on flats
along Ohau Channel.

They are protected here in the spring, but have easy access through the stream to the lake.

We return to our hotel and are taken on a tour of the Whakarewarewa thermal region by Maori women guides. I try several pictures. The guides give us the usual explanations and stories about the various hot pools and springs and the early Maori settlements. The whole thermal area covers several acres. On the whole, the phenomena are similar to those in Yellowstone Park in the United States. Here the geysers are somewhat less dramatic.

I get back to the hotel just in time for dinner. After dinner I go directly to bed.



K-1723 February 11, 1949
New Zealand. Rotorua. Geyser.



K-1724 February 11, 1949
New Zealand. Rotorua thermal area. Hot pool
used for cooking.



K-1725 February 11, 1949
New Zealand. Rotorua thermal area. Boiling
mud pots.



K-1726 February 11, 1949
New Zealand. Rotorua thermal area. General view
of thermal area.

February 11

We are in the bus and away at 9:30 a.m. An attempt
 start was attempted, but it just won't be done in New
 Zealand (or Australia)! We go generally south and see
 forest plantings to the east for several miles, the
 strongly rolling to hilly scrub land to the west. The



K-1727 February 11, 1949
 New Zealand. Rotorua thermal area. Prince of
 Wales geyser.

February 12

We are in the bus and away at 9:00 a.m. An early start was attempted, but it just can't be done in New Zealand (or Australia)! We go generally south and pass forest plantings to the east for several miles, and strongly rolling to hilly scrub land to the west. Here some pines are coming in from wind-borne seed. Beyond, there is scrub with small patches of grass and of natural forest. We pass a small fault scarp formed at the time of the eruption of 1886.

We pass Rainbow Mountain, where recent ash lies a few feet over buried soil. We go for a long way through scrub land, much of which can be, and probably will be, developed for dairy farms now that the cobalt problem has been worked out. We pass through the Reparoa settlement on soils from Taupo pumice ash. Except for a few farms, this doesn't look very good. Some patches of soil are imperfectly drained. Considerable hay needs to be harvested here. Some of it is baled in the field with modern machinery. Most of it is put into stacks by the older methods. In the undulating (locally called "easy") country here, road cuts show that the pumice ash has been reworked by water.

We again cross the Waikato River and pass a great burn of over 30,000 acres of private forest plantings (fire in 1946) and then into strongly rolling country.

Today we again have exceedingly dusty roads. It is an unusually irritating siliceous dust.

We stop for a moment in a section of the old burn. The regeneration of radiata is about 2 to 3 feet high and exceedingly thick.

We come back again to the immediate valley of the Waikato on a strip of unused, nearly flat land. Our schedule calls for a stop to examine another thermal area -- the Wairakei Geyser Valley. We spend nearly 2 hours here. Ten minutes would have been enough for me. There are more tiny geysers, boiling mud pots, and so on, along the margin of a deeply trenched stream. Most of the country here is hilly, dissected scrub land with a few pines coming in.

We go on and pass Huka Falls -- a beautiful sight -- on the Waikato River. We stop at Taupo for lunch.

The area seen this morning is dry. It gives a general impression that reminds me of the hilly, sandy moraines and pitted, outwashed plains of the Northern Lake States. Actually, of course, this soil is not so dry as that and much of it will



K-1728 February 12, 1949

New Zealand. Thirty-one miles south of Rotorua.

Regeneration of pine (P. radiata) after burn in 1946.



K-1730 February 12, 1949
New Zealand. Forty-eight miles northwest of Napier.
Mostly Regosols.

be developed for dairying in the future. The rainfall in Rotorua is 50 inches, and here in Taupo it is about 44 inches.

We go southeast of Taupo onto a gently rolling to strongly rolling volcanic plateau covered with scrub in which a few pine are appearing. This area is called the Kaingaroa Plains. The rainfall is around 50 to 60 inches, but the area is frosty and most of the soils are rather strongly leached. Some of the higher areas are only gently undulating. Here the scrub grows poorly, and poorest of all in the frosty pockets that have mostly the tussock grasses.

We cross the Rangitaiki River (elevation: 2200 feet), which runs north into the Bay of Plenty. Superficially, the landscape reminds one of the sagebrush plains of the northern Great Basin in our West. The land is not used for anything. A few wild horses may be seen.

Then we enter a range of hills -- very hilly -- with the natural forest on the tops. We pass Old Orchard at 2400 feet. There is steeply sloping forested land to the east of us that is mostly second growth or scrub following fire. Some of it is exceedingly steep. In very deep cuts, the basic graywacke

underlying the pumice ash is exposed. The soils are mainly pumiceous Lithosols or Regosols. There are some slips on the badly burned very steep slopes. In occasional cuts through the coves I see incipient profiles suggesting Podzols. There is said to be local podzolization under the mor-forming trees like the rimu.

Across the Mohaka River, deeply entrenched in soft mudstone, the rocks to the east are sandstone and mudstone of Tertiary age. Here slips are more numerous on the steep slopes. The cover is a bit better on the mudstone. This area is badly infested with rabbits, and consequently there are many hawks.

I photograph some of these slips. They are stimulated more by the burning, prompted by the mistaken idea of improving the grass, than by overgrazing. As we go on, road cuts show that on the gentle slopes the soils have fairly well developed brown B horizons. Much of this area has Brown Forest soils with local podzolic soils of varying degrees of development.

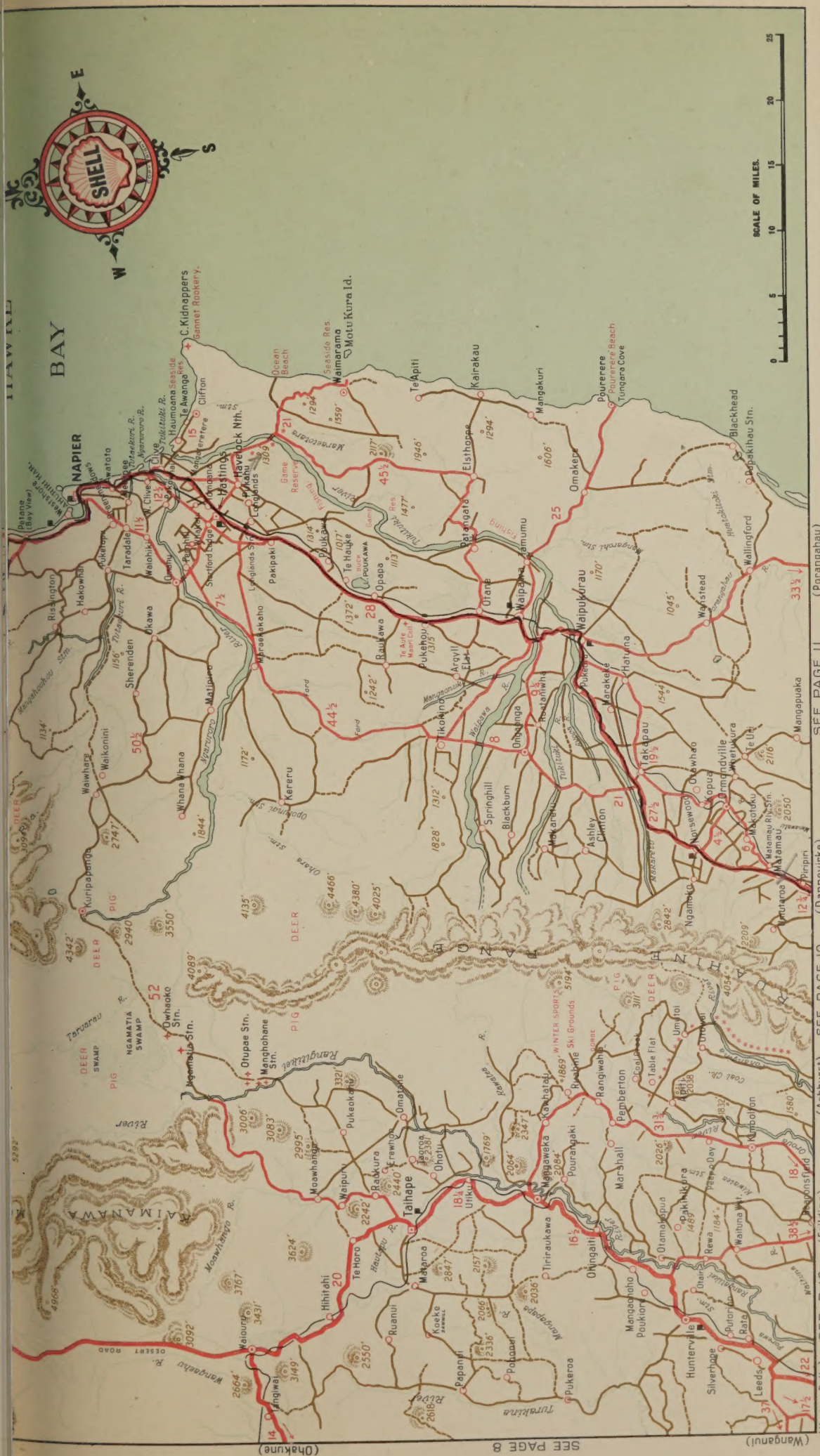
As we drop down from the highest scarp to the lower strongly rolling and hilly land covered with Taupo pumice ash, the cover is better. I see a few planted forests and some



K-1731 February 12, 1949
New Zealand. Forty miles northwest of Napier.
Characteristic slip on steep soils from mudstones.



K-1732 February 12, 1949
New Zealand. Forty miles northwest of Napier.
Characteristic slips on podzolic Lithosol from
mudstone.



SEE PAGE 8 (Ohakune) SEE PAGE 10 (Felding) SEE PAGE 11 (Dannevirke) SEE PAGE 12 (Porangahau)



grazing sheep. Soils far to the east, where the rainfall drops off, appear to have less cover.

About 15 to 18 miles from Napier the land is drier, the soil is grayish-yellow rather than grayish-brown, and the scrub is low. The grass cover is quite good for such a hilly country. Some Angus and Hereford cattle are grazing as well as sheep. As we drive on, road cuts show 6 to 12 inches of dark grayish-brown soil that suggests Prairie or Chernozem. We enter a narrow, nearly level stream terrace used for grazing, alfalfa, and kale for feed. Both dairy cows and sheep are raised. I see some vines and a few pumpkins. The sheep look very nice here. They are the Romney breed that give "medium cross-bred" wool. They originally came from England.

As we near the sea, this valley broadens and we go south in a narrow, nearly level coastal strip with stock farms and some fruits and vegetables. Asparagus is grown on the slightly saline soil for the local cannery. The rainfall has dropped below 40 inches.

We pass Bay View. It is said that in 1931 a severe earthquake nearly destroyed Napier, but raised the lagoon back of it about 7 feet, thus bringing approximately 7,500 acres above sea level. This low-lying land has been reclaimed

grazing sheep. Soils far to the east, where the rainfall drops off, appear to have less cover.

About 15 to 18 miles from Naples the land is drier, the soil is grayish-yellow rather than grayish-brown, and the scrub is low. The grass cover is quite good for such a hilly country. Some Angus and Hereford cattle are grazing as well as sheep. As we drive on, road cuts show 6 to 12 inches of dark grayish-brown soil that supports fruit trees or Citrus. We enter a narrow, nearly level stream terrace used for grazing, alfalfa, and kale for feed. Both dairy cows and sheep are raised. I see some vines and a few pumpkins. The sheep look very nice here. They are the Romney breed that give "medium cross-bred" wool. They originally came from England.

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through drainage; some of it is in pasture that carries 2 to 3 sheep per acre, and some of it is used for vegetables. Considerable acres, however, are still too saline for farming.

Because of our very late start, and because of the hilly land that delayed our bus, we shall be terribly late tonight.

We drive through Napier at dusk and then on into Hastings in the dark. We reach our hotel at 8:00 p.m. -- too late for dinner. I wash, find a little ice cream in a "milk bar," and go to bed very tired and with a very sore back. This day was far too long and not especially interesting. I hope for better tomorrow.



NEW PLYMOUTH RANGE
205 B

NORTH TARANAKI LIGHT
Pukearuhe

SOUTH TARANAKI
BIGHT

DF
OHAKA
2-10 mc ZKY

DF
OHAKA HOMER
116.1 mc

OHAKA
159 LH 69
Airport of Entry
OHAKA TOWER
3105 116.1 mc

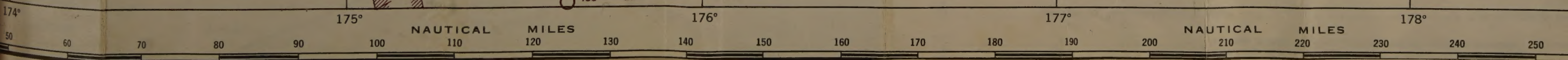


RACON
CHANNEL P
CODE O

R Bn
OHAKA
220 OH

FIELDING
195 22

DANNEVIRKE
626 27



AERONAUTICAL SYMBOLS

AIRCRAFT FACILITIES

PORTS—COMPLETE FACILITIES Refueling services, complete repairs, shelter, and (where applicable) passenger or cargo services and/or seaplane ramp with hauling-out facilities.

AIRFIELDS or SEAPLANE PORTS—LIMITED FACILITIES Refueling services for normal traffic and limited repair facilities.

APLANE LANDPLANE

- Military Base
- Civil
- Joint Civil and Military Base

SEAPLANE LANDPLANE

- Military
- Civil
- Joint Civil and Military

LANDING GROUNDS and ANCHORAGES

- Landing Strip—Very limited or no facilities
- Landing Area—Very limited or no facilities or information thereon not complete
- Sheltered Anchorage—Very limited or no facilities
- Emergency Anchorage—Very limited or no facilities or information thereon not complete

AIRFIELD DATA

- Elevation in feet
- Minimum lighting; obstruction, boundary or runway lights and lighted wind indicator
- Hard surface runway, normally all-weather
- Normally sheltered take-off area
- Length of longest runway to nearest hundred feet

ASANSOL
300 LH 60

TARANTO
3 LS 99

ASANSOL
300 -H 60

TARANTO
3 -- 99

When specific information pertaining to landing facility data is lacking, the respective character is replaced by a dash (-).

AIR NAVIGATION LIGHTS

Numerals in italics indicate elevation above mean sea level.

- Flashing Light (With code)
- Obstruction Light
- Marine Light (Elevations of marine lights are above high water.)
- Lightship

F—Fixed
Fl—Flashing
Occ—Occulting
Alt—Alternating
Gp—Group
R—Red
W—White
G—Green
B—Blue
(U)—Unwatched
SEC—Sector
sec—Second

Marine lights are white unless colors are indicated; alternating lights are red and white unless otherwise indicated.

MISCELLANEOUS

- Floating Mast
- Visual Ground Sign
- Town having Visual Ground Sign
- High Explosives Area (Marked)
- High Explosives Area (Unmarked)

AERONAUTICAL SYMBOLS

RADIO FACILITIES

All frequencies are kilocycles unless otherwise stated. Use of the word RADIO, AIRWAYS, CONTROL or HOMER within the box indicates "Voice facilities". RBn preceded by the letter M indicates a Marine Beacon.

Radio Range
(With voice)

WOODY RADIO
291 AB

Radio Range
(Without voice)

WILLOW RANGE
320 KB

Radio Range
(Very high frequency with voice)

BELT RADIO
109.1 mc MT

Radio Direction Finder
(With voice)

DF
MANUA HOMER
116.1 mc

Radio Fan Marker Beacon

ARK

Non-Directional Radio Beacon
(Without voice)

R Bn
EVERETT
224 MMC

Radio Communication Station
(With voice)

CS
GOWEN AIRWAYS
4220

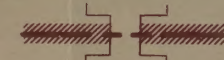
Radio Communication Station
(Without voice)

CS
KAZAN
5200 WYZW

Radio Broadcasting Station

BS
WOL
1260

International Boundary
(Closed to passage of aircraft except through air corridor)

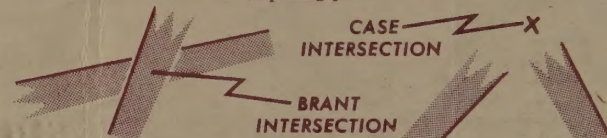


AIRCRAFT LANDING FACILITY INFORMATION

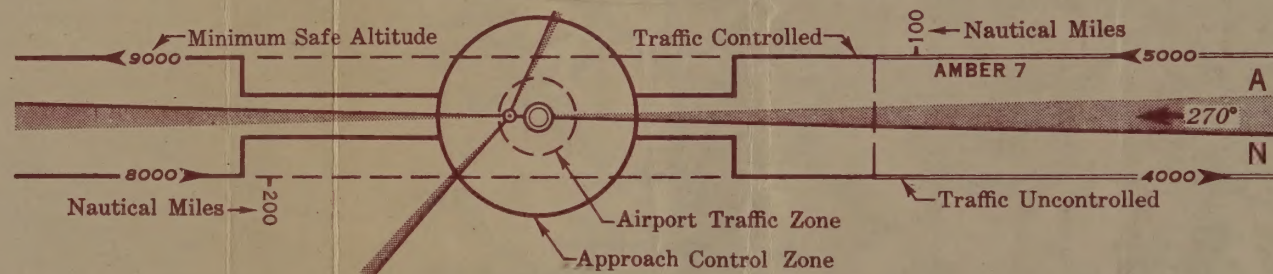
HARMON FIELD
18 LH 46
Airport of Entry
VHF/IA System
GCA System
HARMON TOWER
278 116.1 mc

RADIO FIXES

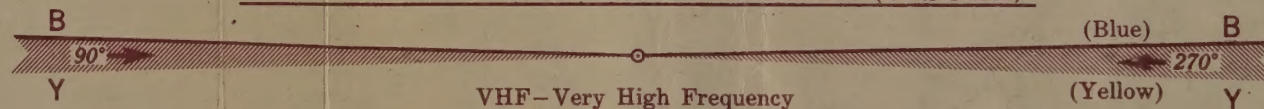
Reporting point.



AIRWAYS & RADIO RANGE (AURAL)

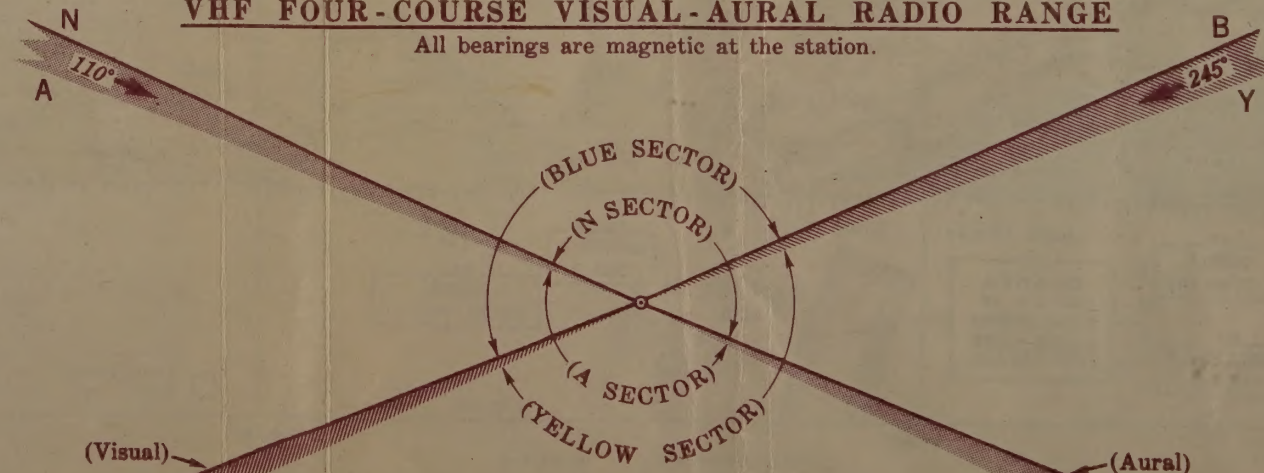


VHF TWO-COURSE RADIO RANGE (VISUAL)



VHF FOUR-COURSE VISUAL-AURAL RADIO RANGE

All bearings are magnetic at the station.



February 13

I am up at 6:30, write some letters, and prepare kodachromes for mailing home. Again we get a late start -- 9:15 a.m.

We drive east over smooth land with dairy farms, vegetables, and fruits (pears, asparagus, potatoes, peaches (Golden Queen), plums (Santa Rosa), sweet corn, apples,^{1/} alfalfa, and pumpkins) to a high peak. We pass through Havelock North, where there are nice flower gardens with palms. Here the rainfall is around 32 inches.

We are soon on the upland soils, called "yellow-grey earth," from fairly limy, pumiceous, muddy sandstone, with limestone underneath. The soils are very strongly rolling to hilly and have excellent grass cover. For such strong slopes, there are few slips. I examine some of these surfaces carefully and find that there are a great many old slips now regrassed. I am told that during drought periods slips appear, but that after a few wet years they are again covered. Now the grass is said to be better and greener than usual, due to above average January rainfall. Although

^{1/} Varieties include Sturmer, Delicious, Golden Delicious, Rome Beauty, Granny Smith, Ballarat, and Cox's Orange.



K-1733 February 13, 1949
New Zealand. From Te Mata Peak east of Hastings
looking toward Napier.

there are no frosts at Hastings,^{10*/} there are some in these soils. In the hills near Te Mata Peak the land is used for breeding ewes, fat lambs, and some fat cattle. In addition, there are about 14,000 acres of orchard. In the immediate plain to the north -- the Heretaunga Plains -- there are about 60,000 acres. Some 30 miles on, there is another plain of 40,000 acres. The soils of these plains are somewhat unusual in New Zealand, since they need but little phosphate. Phosphate is needed for grass on the hills to the west.

With some difficulty and with considerable indifference for my fellow travelers, I stop to look at the soil, locally called a Rendzina, down the slope from Te Mata. I shouldn't call it so, especially because of the developed B. It appears to me to be possibly a degraded Prairie soil.

A ₁₀	0-6"	Very dark gray fine sandy loam. Many grass roots, especially in the upper part. Softly and finely granular.
A ₁₁	6-8"	Like above, but faintly mottled with grayish-yellow.
A ₂	8-13"	Fine sandy loam, with medium rounded nut structure. The aggregates are yellowish-brown on the inside, softly mottled with dark gray, and have coatings of very pale brown, almost gray. (The characteristic structure of the A ₂ of degraded Chernozem.)

A ₃	13-15"	Transitional.
B ₂	15-26"+	Yellowish-brown to dark yellowish-brown clay, with angular nut structure.
C	(depth)	Weathered shell limestone.

The slope here is about 60 percent. The land is strongly rolling to hilly. Although now covered with grass, I suspect the soil may have been formed under grass and then invaded by scrub prior to settlement. Likely the probable trend toward forest was erased by land management practices. The scrub was burned off and the grass is now maintained. A little farther down the slope I see a very similar profile, but I don't take time to describe it. Yet, with downright discourtesy to my hosts, I take a few minutes to describe a so-called "yellow-grey earth" from muddy sandstone. Here the soil is strongly rolling. I regard it as a far-gone degraded Prairie and almost a Gray-Brown Podzolic soil.

A ₁	0-3"	Medium to dark gray fine sandy loam; clods are easily friable to powdery fine granular.
A ₂	3-13"	Mottled light gray and dark gray, heavy fine sandy loam. Very faintly prismatic. Brittle, and fairly easily friable.
A ₃ or B ₁	13-18"	Light yellowish-brown (10YR 6/4) clay loam, mottled with gray along the root channels. White floury coatings on the aggregates. Coarsely prismatic and blocky.

A ₃	13-15"	Transitional.
B ₂	15-25"	Yellowish-brown to dark yellowish-brown clay, with angular and structure.
C	(depth)	Weathered shell limestone.

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A ₁	0-3"	Medium to dark gray fine sandy loam; clods are easily friable to powdery fine granular.
A ₂	3-13"	Mottled light gray and dark gray, heavy fine sandy loam. Very relatively prismatic. Brittle, and fairly easily friable.
A ₃ or B ₁	13-18"	Light yellowish-brown (10YR 6/4) clay loam, mottled with gray along the root channels. White flowy coatings on the aggregates. Coarsely prismatic and blocky.

B ₂	18-25"	Yellowish-brown, coarsely prismatic and blocky clay. Friable only with difficulty.
B ₃	25-40"	Yellow clay or clay loam, mottled with yellowish-brown in the cracks. Coarsely blocky. Friable with some difficulty. Flattened roots on the sides of cracks.
C	40-50"	Grayish and yellowish weathered muddy sandstone, grading into hard rock.

Where exposed, the B₃ hardens into a fairly dense pan. Like the other area, I suspect this was once grassland and was then invaded by forest and degraded. In recent times, the scrub and forest have been largely eliminated by fire and the land maintained in grass. In the deep coves, there are a few planted pines.

It is a great pity that I must always hurry so. We now go to have tea at Chesterhope Farm near Hastings. Mrs. D. Fernie is our hostess. She has a beautiful garden with many kinds of flowering plants. We drive for a few minutes over some of the beautiful pastures on this farm used for breeding ewes, fat lambs, and beef cattle. These are on stream terraces. Then we go back to the hotel for a leisurely lunch and are in the buses at 2:00 p.m. It is very difficult to make arrangements on Sunday in New Zealand, since everything is shut up completely tight.

Southwest of Hastings about 3 or 4 miles beyond Waipukurau, the bus driver changes a tire, so I get a chance to look at the soil. The land is strongly rolling to hilly and now covered with grass.

- | | | |
|----------------|------------------|--|
| A ₁ | 0-5" | Nearly black to black silty clay loam. Mixed granular and fine blocky. |
| A ₃ | 5-13" | Very dark brown silty clay. Coarse prismatic that falls into angular nut. The aggregates in the upper part have nearly black coatings. |
| B ₂ | 13-18"
(6-24) | Brown to dark brown clay (7.5YR 4/4). Massive when moist; when dry, medium angular nut. Roots penetrate. |
| B ₃ | 24-30"
(9-40) | Reddish-brown clay, flecked with white fragments of limestone. Plastic. |
| D | | Yellowish-white shell limestone. |

Many tongues of the horizons extend deeply in the cracks. The surface is thickened in the coves. Here the soil lacks the degraded A₂; but just across the road, where the solum is deeper over the rock, the soil is similar to the first one described this morning. Here the rainfall is only about 30 inches. We then cross the Takapaua Plains -- old alluvial plains with "yellow-brown loam." Some of the soils are stony. Most of the land is in pastures and meadows, although part of it is used for intertilled crops. Fat lambs

Southwest of Hastings about 3 or 4 miles beyond
Welpurran, the bus driver changes a tire, so I get a
chance to look at the soil. The land is strongly rolling
to hilly and now covered with grass.

A ₁	0-2"	Nearly black to black silty clay loam. Mixed granular and fine blocky.
A ₂	2-13"	Very dark brown silty clay. Coarse prismatic that falls into angular nut. The aggregates in the upper part have nearly black coatings.
B ₂	13-18" (6-24)	Brown to dark brown clay (V. S. 10-14). Massive when moist; when dry, medium angular nut. Roots penetrate.
E ₂	24-30" (9-40)	Reddish-brown clay flaked with white fragments of limestone. Plastic.
D		Yellowish-white shell limestone.

Many tongues of the horizons extend deeply in the cracks.
The surface is thinned in the coves. Here the soil lacks
the degraded A₂; but just across the road, where the solum
is deeper over the rock, the soil is similar to the first
one described this morning. Here the red soil is only about
30 inches. We then cross the Takapuna Plains -- old
alluvial plains with "yellow-brown loam." Some of the soils
are stony. Most of the land is in pastures and meadows,
although part of it is used for intertilled crops. Fat lands

are produced, along with some beef cattle. Both pastures and sheep appear to be excellent. Both white clover and subterranean clover are used. On the average, these lands carry 1 to $1\frac{1}{2}$ ewes per acre, but some fields are better than others. We pass occasional poorly managed pasture foul with thistles. I see a very few fields of kale -- possibly Thousand-Head used for feed. As we go on, the rainfall increases to nearly 50 inches. On the whole, this is beautiful farming country.

As we go south and west in the watershed of the Manawatu River, dairying increases. The soils are said to be "yellow-brown loams" with an average carrying capacity of 2 ewes per acre or 110 to 130 lbs. of butter fat.

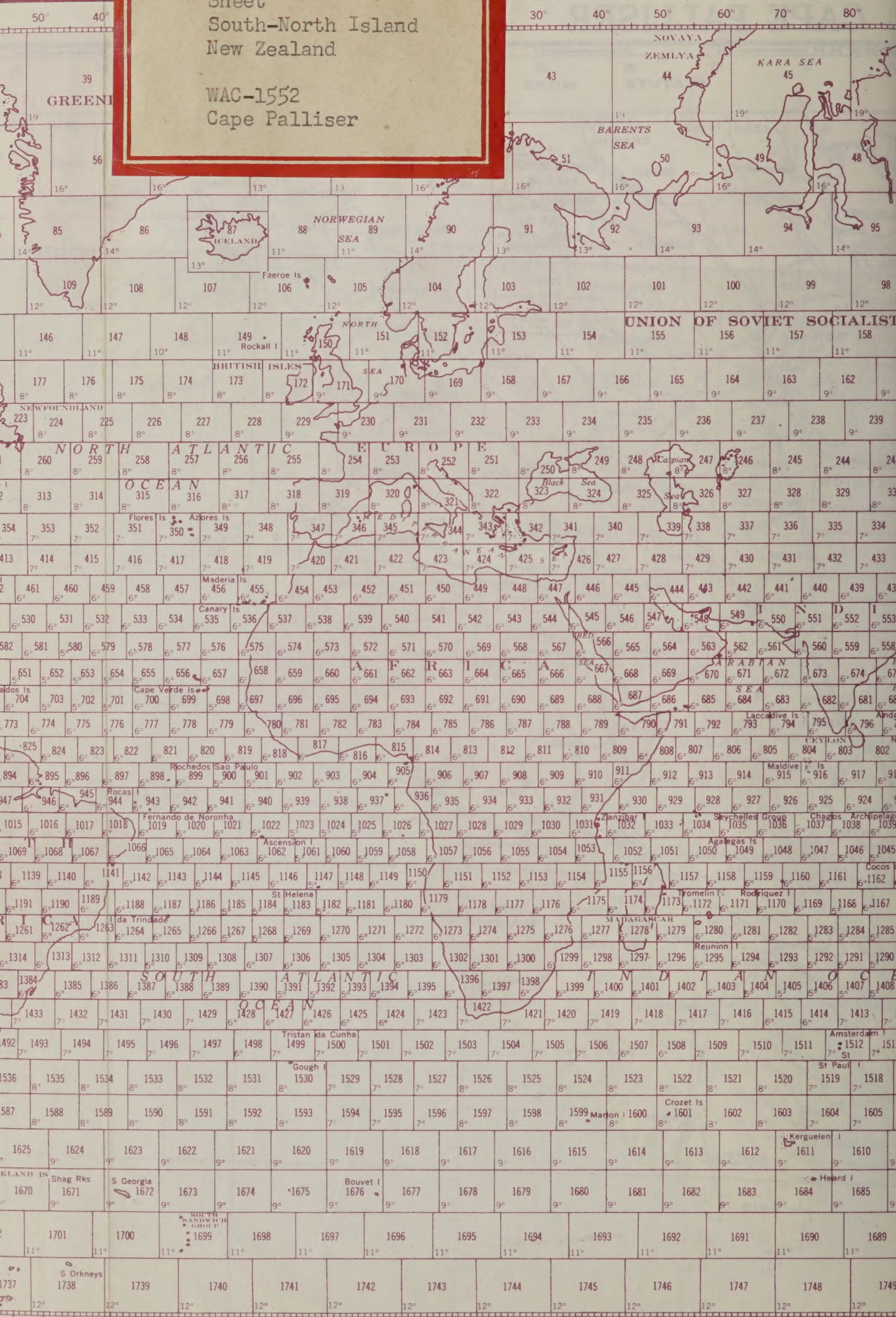
We pass Dannævirke, in a district that was originally covered with a dense forest. Here there are "yellow-brown loams" in a broad alluvial plain. The terraces are quite gravelly beneath. The pastures look a bit dry. These pastures are used mainly for dairy cows and sheep. Then we pass over some lowland pastures used mainly for sheep and beef cattle. These are said to carry up to 3 ewes per acre.

We arrive at the Grand Hotel in Palmerston North, about 6:00 p.m. in a light rain.

S 4000 - E 17500/400x800



WAC-1552
Cape Palliser



February 14

Today I leave the main party and go to Wellington in a car with H. S. Gibbs and Dr. Grange of the Soil Bureau. It is still raining.

We stop about 2 miles out to see a "strongly gleyed yellow-grey earth" on an old terrace high above the present flood plain. This undulating, trenched plain was originally covered with heavy forest.

- | | | |
|----------------|--------|---|
| A ₁ | 0-5½" | Pinkish-gray (7.5YR 6/2) very fine sandy loam. Mixed small rounded nut and fine granular. Highly vesicular. Fairly easily friable. |
| A ₂ | 5½-9" | Very pale brown silt loam, slightly mottled with shades. Vesicular. Seems massive in place, now dry; but digs out in fairly friable, rounded, irregular small and medium nut. |
| B ₂ | 9-24" | Mottled gray, pale yellow, yellow, and reddish-yellow hard silty clay. Medium to coarse angular blocky. Compact. |
| | | Grades into: |
| B ₃ | 24-40" | Reddish-brown clay loam material, grossly mottled with shades. Some vertical cracking. Angular nut structure. The soil is more friable along the root channels. It is more friable as a whole than the B ₂ . |
| C | 40-60" | Much like B ₃ , but still more friable. |



K-1734 February 14, 1949
New Zealand. Fifteen miles south of Eketahuna.
View on "moderately leached, moderately weathered
yellow-brown earth" on Pleistocene sediments over
graywacke. (Close to Brown Forest)



K-1773 February 14, 1949
New Zealand. Near Eketahuna. Toetoe grass.

The incipient clay pan makes one think of the Planosol, but not all the way. The mottling suggests a Gray Hydromorphic. The land is gently undulating and imperfectly drained, even though it looks to be on relatively high terraces. Either mole or tile drains are necessary for the best pastures. Lime and phosphate are both necessary. In the United States we should likely need to place this soil somewhere between the Planosol and the Gray Hydromorphic, although that is not a good fit.

We pass Woodville.

We go south over rather recent low terraces with 50 to 60 inches of rainfall. Most parts are imperfectly drained. The land is highly developed for dairying and fat lambs. We pass Pahiatua. Here there are some fairly well drained terraces with Mangaroa loam -- one of the "yellow-brown loams."

We pass Eketahuna and go left on a secondary road into strongly rolling high country to look at a "moderately leached, moderately weathered yellow-brown earth" from Pleistocene sediments over graywacke at great depth. Originally this land was forested. Now it is in grass for sheep. At about 15 miles south of Eketahuna, I look at the soil where the slope is about 30 percent. The rainfall is somewhat over 50 inches. This soil could go in with the Brown Forest.

The incipient clay pan makes one think of the Pliocene, but not all the way. The mottling suggests a Gray Hydro-morphic. The land is gently undulating and imperfectly drained, even though it looks to be on relatively high terraces. Either mole or tile drains are necessary for the best pastures. Lime and phosphate are both necessary. In the United States we should likely need to place this soil somewhere between the Pliocene and the Gray Hydro-morphic, although that is not a good fit.

We pass Woodville.

We go south over rather recent low terraces with 20 to 60 inches of rainfall. Most parts are imperfectly drained. The land is highly developed for dairying and fat lands. We pass Fairview. Here there are some fairly well drained terraces with Mangrove loam -- one of the "yellow-brown loams." We pass Ekatahuna and go left on a secondary road into strongly rolling high country to look at a "moderately leached, moderately weathered yellow-brown earth" from Pliocene sediments over graywacke at great depth. Originally this land was forested. Now it is in grass for sheep. At about 15 miles south of Ekatahuna, I look at the soil where the slope is about 30 percent. The rainfall is somewhat over 50 inches. This soil could go in with the Brown Forest.

- | | | |
|----------------|-------------------|---|
| A ₁ | 0-7"
(6-12) | Yellowish-brown (about 10YR 5/4), mottled with dark yellowish-brown, silt loam to silty clay loam. Small to medium subangular blocky, with some granular. Aggregates are firm. Friable with difficulty. |
| A ₃ | 7-20" | Yellowish-brown (10YR 5/6), mottled a bit with dark yellowish-brown, silty clay loam. The soil is darker near the roots. Subangular and angular medium and small nut. Friable under hard pressure. |
| B | 20-32"
(24-40) | Yellowish-brown, mottled with light yellowish-brown, silty clay loam. Poorly developed medium, coarse, angular blocky. Easily friable. |
| C | 32-50"+ | Light yellowish-brown, fine sandy silty clay, faintly mottled and streaked with brownish-yellow. Massive in place, but digs out in easily friable, coarse, irregular blocky. (Pleistocene sediments) |

This soil is used for beef cattle and sheep. The structure is excellent for grass. Even though fairly acid -- pH 5.5 to 6.0 -- it does not respond to lime, although phosphate is required.

We drive on to Masterton. I see some wheat, red clover, and feed kale, as well as pasture on the well-drained terraces. Much of the soil has coarse gravel and cobbles near the surface.

It stops raining.

As we drive on, the rainfall decreases and the soil becomes grayer in the surface and paler beneath.



K-1735 February 14, 1949

New Zealand. Fifteen miles south of Masterton.

Sheep station on "yellow-grey earth" soils and their
"skeletal" associates.

410

0-2 1/2"

Grayish-brown

loam, very

friable, very

brown gray

After lunch in Masterton, we drive south, east of the main road, into strongly rolling hills from the fine sandy mudstone. They look dry now. The cover is mainly open grass with a few clumps of trees. The soil cracks deeply. With sudden, heavy rains on the dry soils, serious slips develop. On the hills from limestone, there are almost no slips, even on the very steep slopes. Here the rainfall has dropped off to 35 or 40 inches. The soils are "yellow-grey earth." On the "easy" land, some of the soils are "moderately gleyed." I see a few fields of turnips. There are nice farmsteads along here.

About 15 miles south of Masterton, I photograph one of the sheep stations on the rolling "yellow-grey earth" and its "skeletal" associates developed from mudstones of Tertiary age. Sheep stations like this have about 1,000 to 2,000 acres with 2,000 to 4,000 sheep.

We turn west. A plowed field on the terrace discloses a soil nearly as dark in the surface as a Prairie soil. In 3 or 4 miles, we come into rolling country with Pleistocene muddy, sandy sediments over gravels. I examine a dried road-cut face. Here the land is undulating.

A₁₀

0-2½"

Grayish-brown (2.5Y 5/2) fine sandy loam. Medium to fine, firm but friable, granular. Well matted with brown grass roots.

See photograph.

A ₁₁	2½-3½"	Transitional.
A ₂	3½-8½"	Grayish-brown to light grayish-brown (2.5Y 5/2 to 6/2) very fine sandy loam. Very irregular small clods are easily friable to soft fine granular.
BG ₁	8½-23"	Light gray, mottled with white, gray, and yellow, silt loam. Some irregular cracking, mainly vertical, but soil is massive to coarse irregularly blocky. Fairly easily friable under pressure. Faces of the blocks are light gray to white. Both mottling and blocks are coarser in the lower part.
BG ₂	23-36"	Pale yellow to pale brown silt loam. Rich in very fine sand. Some cracking into large blocks. Friable with difficulty. The material in the cracks is light gray where exposed in the road cuts.
		Grades into:
C	36-60"+	Pale yellow, massive silt loam or very fine sandy and silty clay. Coarse vertical breakage. Vesicular. Fairly easily friable. The exposed surfaces of the old cracks are nearly white. At 6 to 12 feet, the material is yellow.

This soil shows in the curved cracking the gammate features described by Taylor.^{1/}

Gibbs interprets the BG₂ as defined above as the C. The lumps in the BG₁ he regards as C, and the material along the cracks in the BG₂ as B. This BG₂ suggests some tendency toward

^{1/} See photograph.



K-1774 February 14, 1949
New Zealand. Northeast of Carterton. Roadcut in
"yellow-grey earth" (?) showing some glei and some
"gammate."

a silt pan, or a zone of maximum clay formation. Yet I should include it in the solum. It surprises me to find soils with these obvious hydromorphic features on well-drained, undulating to rolling surfaces. Perhaps the land has been only recently trenched. At least most of the land here has been recently uplifted. But as we drive along the road, the BG₂ showing up in the road cuts appears to parallel the surface.

This is a very difficult soil to place. If we should find it in our southern States, we should likely put it with the Yellow Podzolic and marvel at its productivity. I shouldn't want to give it any international name that I know about. Even though it has obvious glei features, it probably is some kind of zonal soil.

We join the main road north of Carterton and drive on toward Wellington quite rapidly, where we arrive about 5:00. We stop at the Soil Bureau for a few moments and then go on to my hotel -- the Waterloo. I have a very nice room with private bath! But no key!

Hotels in New Zealand and Australia are linked with the saloon, from which they make their biggest profits. On the whole, hotels are better in New Zealand than in Australia and the proprietors a bit more courteous. Still one must be

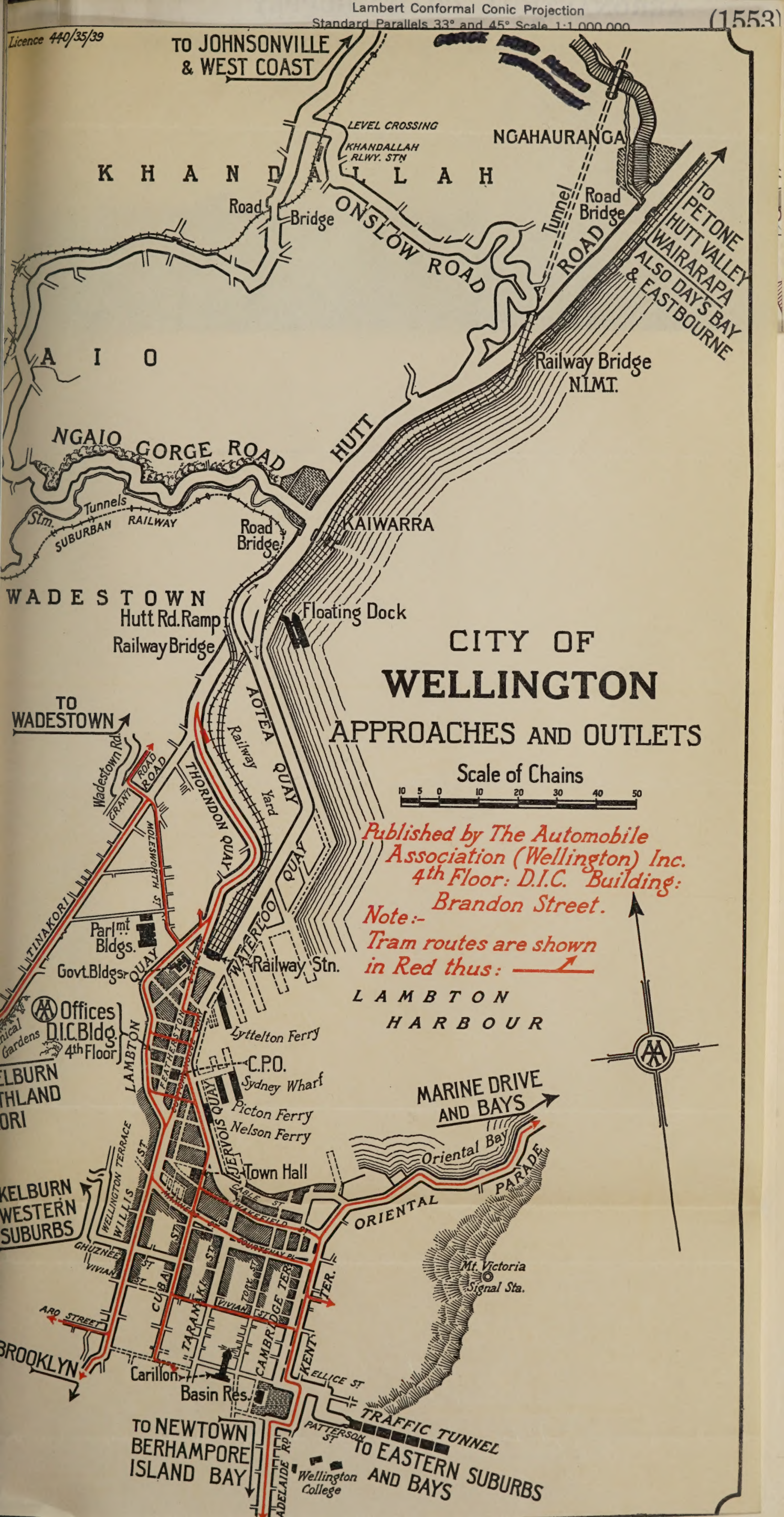
or grass and scrub by the Maoris after they came about the beginning of the 13th Century. Then many of the scrub areas have been converted to grass by Europeans during the past few hundred years through burning and seeding and the application of lime and fertilizers, especially phosphate. Of course, the change from strong podzolizing trees to scrub makes a big change in the soil. The manuka shrub seems to leave a large amount of dark humus on the soil. Then grass produces another change. Less is probably returned to the soil under intensive grazing than under wild grass, where soils are naturally fertile. Yet when mineral deficient soils are fertilized, the grass is still more effective, even though grazed. In many places wild grass grows poorly or not at all; while cultivated grass, which has been properly fertilized, grows exceedingly well. Generally, soils here seem to be higher in organic matter and nitrogen than one should expect with superficially similar soils in continental regions.

Then too, the climate is unlike that of continents. Palms grow far south of what one would expect. Soils of the temperate area here in the south part of the North Island never freeze; although some like those seen today become dry in the surface during summer periods. One sees hydromorphic features on

land of considerable slope and apparently good drainage. This may be due in part to very high contents of coarse clay, silt, and very fine sand, with low amounts of fine clay. Such soils do not crack a great deal; and during the long moist seasons, water needs to go through the fine pores, and does so very slowly.



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SCIENTIFIC STATIONS IN NEW ZEALAND



THE SOIL BUREAU

By N. H. TAYLOR

Assistant Director, Soil Bureau

THE FIRST and second bulletins of the *Scientific Inquiry New Zealand* series dealt in turn with the work and organization of the Department of Scientific and Industrial Research and the Dominion Laboratory. This bulletin describes the younger research branches, the Soil Bureau, whose object is to study and map the soils of New Zealand.

Soils as a basis of agriculture have been studied for a long time; in fact, there is a record of a soil survey carried out to 2000 B.C. when, in the reign of the Emperor Yao, the engineer Yu drew up a classification of soils based on texture and structure. It was not until near the close of the nineteenth century, however, that the method of soil formation became understood and that soil science, or pedology* as it is really called, came into being. The foundation work in this science was carried out by Dokuchaiev and Glinka in Russia, and by Marbut in the United States of America.

In New Zealand early soil work was done by Mr. J. H. Aston of the Department of Agriculture, by Sir Thomas McCulloch of the Cawthron Institute in Nelson, and by Dr. H. J. Wood of the Geological Survey. By 1930 the value of soil science was beginning to make itself felt, and it was decided to form a separate Soil Survey Branch under the Department of Scientific and Industrial Research. In the early years of its formation, this Soil Survey Branch was quite small. Its first work was by examining the volcanic ash which covers the plateau of the North Island and showed that busckia, a deficiency disease in sheep and cattle, was confined to the volcanic soil. It then studied the soils of the dairying districts of the Waikato and in western Taranaki and produced maps showing the distribution of the soil types in those districts.

* From two Greek words: *pedon*, ground or earth, and *logos*, study.



D. Raeside.

s and district chemists discuss a soil profile near Masterton.

on as these maps had been prepared, agriculturists
ee how useful they would be to New Zealand farmers.
g trials and other experimental work could be done
greater precision once the soils were mapped, and
ed on these trials could be given to farmers who were
n the same kinds of soil. In 1936 the work of the Soil
anch was extended, and surveys were begun in North
and in Hawkes Bay. These surveys were carried out
help of the Department of Agriculture, so that the
n needed by farmers could be set out beside each soil

ess in soil studies in New Zealand has been rapid.
soil map of the whole of the North Island on a scale
es to one inch had been prepared, and in the laboratory
ary chemical examination had been made of each of
pes mapped. In the South Island, surveys had been
he Ashburton county, of parts of Banks Peninsula,
Wairau Plains, while considerable areas in the Nelson
ad been mapped by the Cawthron Institute. In 1943
f the high-country sheep stations were mapped, and

the extent to which the soils were eroded was recorded in form. Good progress has also been made on the general mapping of the South Island. Westland, Marlborough, and Southland have already been mapped and, by the end of 1946, a survey of the plains and downlands of Canterbury and Otago will be almost completed.

Organization

By 1946 the work of the Soil Survey Branch had become much wider in scope. The examination of the chemical and physical properties of soils had become more important, and studies in soil-plant relationships were claiming more attention. It was therefore decided to reorganize the Soil Survey Branch. The four Divisions were set up under the new title of Soil Survey Bureau. The work of each Division is shown in the following table.

<i>Survey Division</i>	Studies soils in the field; prepares soil maps; gathers and collates information relating to various soil types; co-operates with other organizations dealing with the land.
<i>Chemistry Division</i>	Determines the chemical properties of the soil; co-operates with the Survey Division in defining soil types; carries out research on soil problems in New Zealand.
<i>Physics Division</i>	Determines the physical properties of the soil for agricultural and engineering purposes.
<i>Biotics Division</i>	Studies soil life and soil-plant relationships in the field and by laboratory studies soil micro-organisms.

The Soil Bureau, as you can see, differs from the Dominion Laboratory about which you read in a previous bulletin. The Dominion Laboratory deals with a variety of problems and its professional officers are chemists. The Soil Bureau on the other hand deals only with soil problems, but to do so it employs men and women with training in geology, botany, microbiology, chemistry, physics, and agriculture.

In addition to the scientific staff of the Soil Bureau there are an office staff, a librarian, and a draughting staff. The draughting staff is to draw maps and diagrams for reproduction by the Survey Division. Most of the staff work in an old rambling building in Mairangi Street, Wellington, opposite the Parliamentary Library.



marks in a soil boundary on his map. Photo: A. J. Metson.

who map the soils of the Wellington district also have
 . Other field men of the Soil Survey have their offices
 rei, Hastings, Christchurch, and Timaru.

Soil Survey Division

men of the Soil Survey Division are pedologists, that
 no map and study soils in their natural environment,
 l forest, on plain and mountainside.

of us think of soil as something which is in our
 mething inert and lifeless. The pedologist, however,
 the soil is an ever-changing body teeming with life.
 s the soil as the product of five, independent, soil-
 ctors—rock, climate, topography, soil life, and time.
 nderstand this better if you study the diagram on
 Under the effects of climate, with its changes in
 nd temperature, the uppermost rocks of the earth's
 umble and decay, forming a mass of rock waste. As
 trickles down through this rock waste, it leaches* from
 ash, and other elements needed by plants and carries

in solution.



them away in the water. In those places where the rainfall is heavy, the process is particularly rapid if it were not for the layer of rock which soon lose the plants it contains. Soil, however, particularly in the struggle against the action of rain. For example, in the case of plant nutrients, as they come down through the soil, they are absorbed by the trees, built up in stems and leaves. At the end, they are returned to the surface as the leaves decay. Whether the soil beneath a tree is fertile, or sour, or washed, depends largely

on the ability of the tree to return plant nutrients to the surface. Over the passage of time, a special type of soil is formed by the kind of tree.

So far we have taken no account of the influence of topography on the soil. On flat and rolling land, topsoil and subsoil are easily distinguished. On steep slopes, however, the distinction is not so clear. As the soil creeps slowly downhill, the topsoil and subsoil tend to mix, and sharp pieces of stone broken from the rock below often find their way into the topsoil. In hollows where water collects, the soil becomes swampy, and the bright brown colours so common on the hillsides give place to colours as grey and cream, mottled with rust.

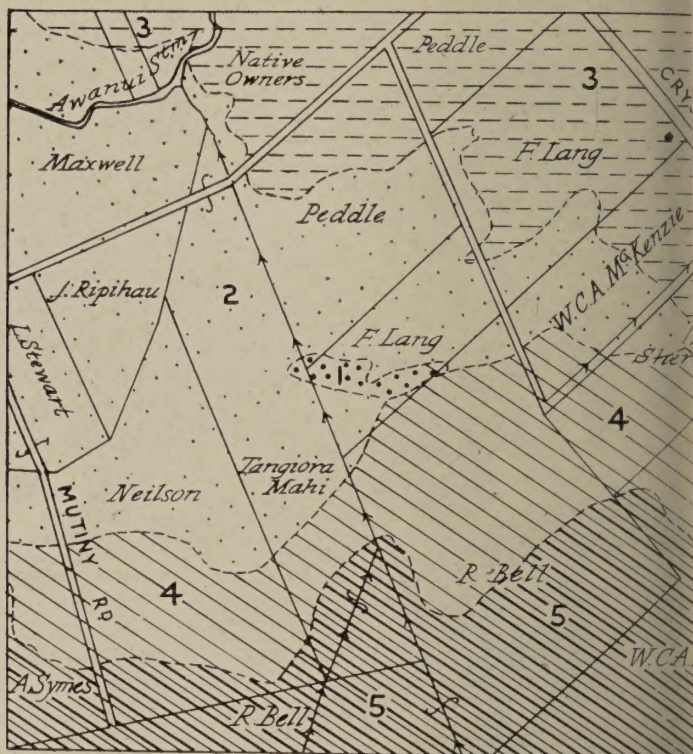
With experience the pedologist learns that the soil is sometimes called a strong "material memory." To understand what "material memory" means if you have worn someone else's shoes. They may be the right size for you, but they are not comfortable because they have taken the shape of, or "remembered," the owner's feet. In a similar way, the soil "remembers" much of its methods of formation. If the pedologist is skilful enough, he can give an account not only of the changes that are taking place within the soil at the present time, but also of the changes that have taken place in the past.



J. Metson.

soil map for the printer. A separate sheet is prepared for each printed black will print as one colour on the final map.

der to study the soils of a particular district, the begins by examining the soil profile, that is, a section psoil and subsoil. He examines all the places where exposed, such as road cuttings, and slips. In other digs soil pits, holes three feet or four feet deep, and records such facts as the colour, texture, and structure at different depths. He then classifies the soil into and begins to make a soil map of the district. For his e-uses one published by the Lands and Survey Depart- by the Geological Survey or, if the survey is a very e, he uses air photographs. On his map he marks in soil types as shown in the map on page 388. During ug, the pedologist generally bores into the soil with a



Map Showing
Soils east of Paki Paki
Hawkes Bay

20 10 0 20 40 Chains

Paki Paki sand *Pumice soil infertile*

Paki Paki coarse sandy loam

Good cereal country, dries out

Paki Paki clay loam *Fertile, fair cropping country*

Turamoe lamy peat } *Moderately fertile*

Turamoe deeper phase } *good grazing country*

Soil boundaries.....

Holding boundaries & owner.....

Drain.....

which is a useful tool for examining the soil down . At the close of the survey, soil samples are collected of the soil types for examination in the laboratory. Soil survey is being carried out, agricultural information about each soil type by the Fields Division of Department of Agriculture. This information, together with , is published in a Soil Survey Bulletin and is available to who wish to use it.

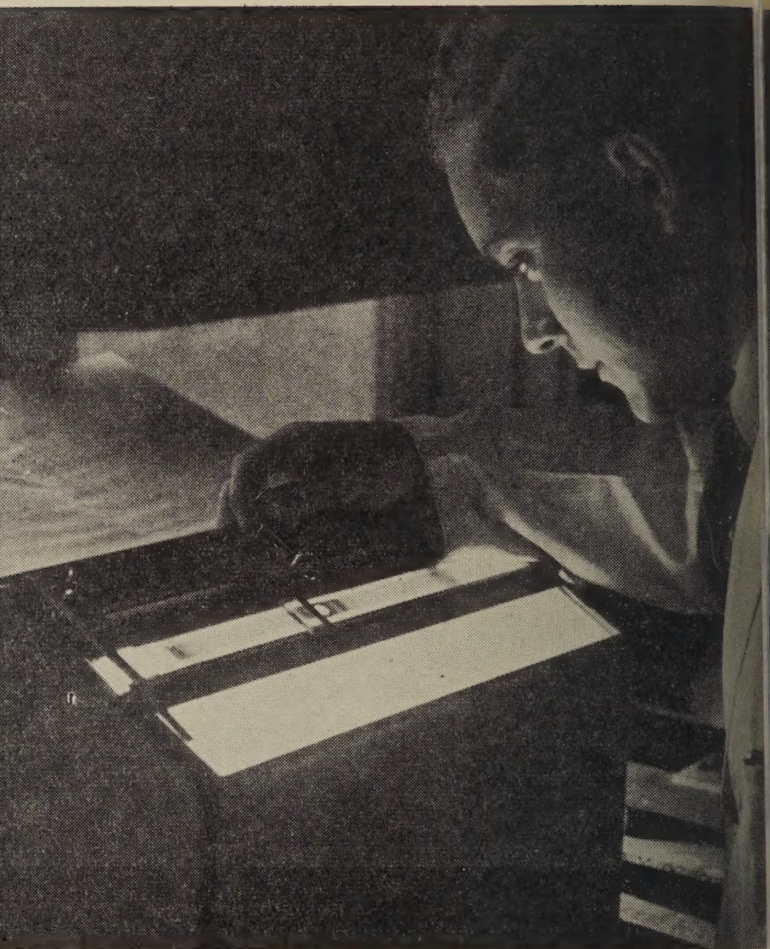
As where there is some particular problem, special often undertaken together with the soil survey: for the Heretaunga Plains a survey was made to study of fruit trees on the various soil types; in the Kai-rikt a survey was made to see which soil should be forest and which reserved for farming; and in Whaiti a special study was made of the farm production soil type, so that the potential value of the various types could be estimated.



Metson.

s in the Godley Valley. This photo was taken during the high country of the South Island.

round of the photograph on page 385.



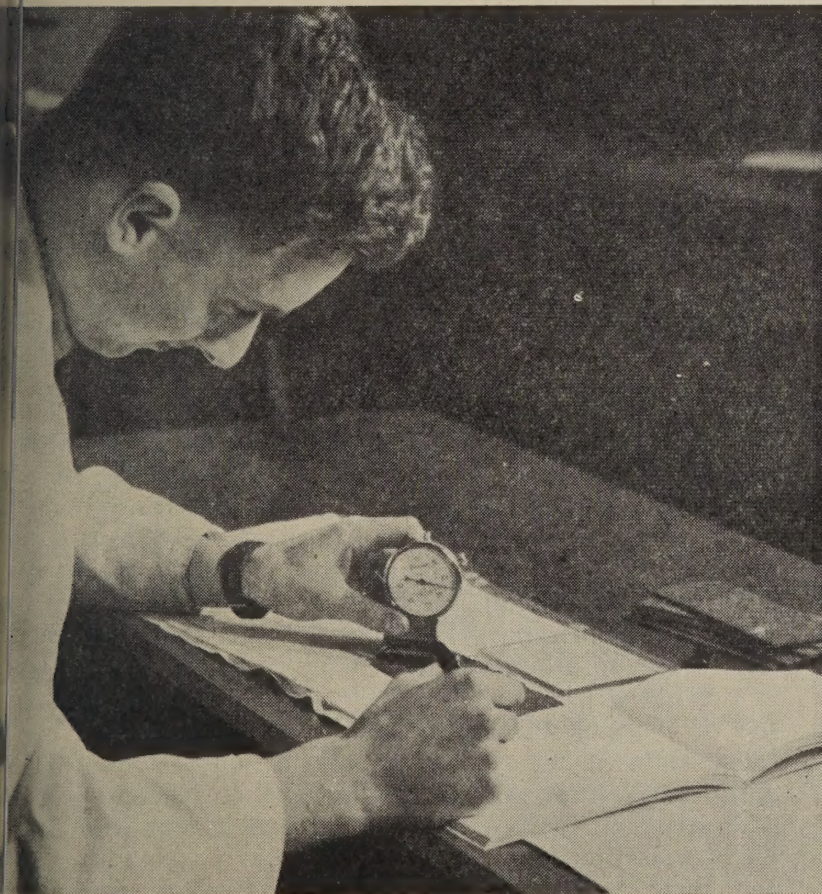
Measuring an X-ray photograph of a soil clay. The small negative in the light box shows, in effect, a magnification of the atom-spacing within a clay molecule.

Photo: A. J.

Soil Chemistry Division

In the Soil Chemistry Division, chemists, known as district chemists, work in close collaboration with the pedologists in conducting the field surveys, while other chemists work on special problems not necessarily connected with any survey in progress. Each of the district chemists is responsible for the investigation of the soil-chemistry problems of a particular district; he is in close touch with the survey party, visiting the field from time to time, where he co-operates in the collecting of samples and takes part in the discussion of soil problems. On returning to the laboratory, he and his assistants analyse the soil-type samples and forward the results to the pedologists in the field. Sometimes

takes additional soil samples when he wishes to study special problem relating to the soils of his district. At the survey, the soil chemist takes copies of the soil maps and colors them in different ways to show the acidity of the soil types, the amounts of lime needed to correct this and the amounts of the various plant nutrients present. The chemist needs to have a thorough knowledge of soil science and a flair for selecting problems worth investigating. Some problems are investigated by specialist chemists. For example, one chemist has been investigating the composition of soil clay. Soil clay is the most finely divided and most chemically active part of the soil. By X-ray pictures and by other means, he has worked out the molecular structure of several of our soil clays. This has thrown some light on the problem of why some soils behave so differently when fertilizers are applied to



g to 1/1000 inch the depth of pits in metal test plates which have been buried in various soils for ten years. The depth to which they are corroded is a practical measure of soil corrosion. Photo: A. J. Metson.

Other investigations undertaken by the soil chemists are those on soil phosphate, the composition of tree litters and the amounts of trace elements in plants. The study of trace elements, that is, elements which occur sparingly in the soil, of which the plant uses only small amounts, is under investigation in co-operation with the Soil Biotics Division.

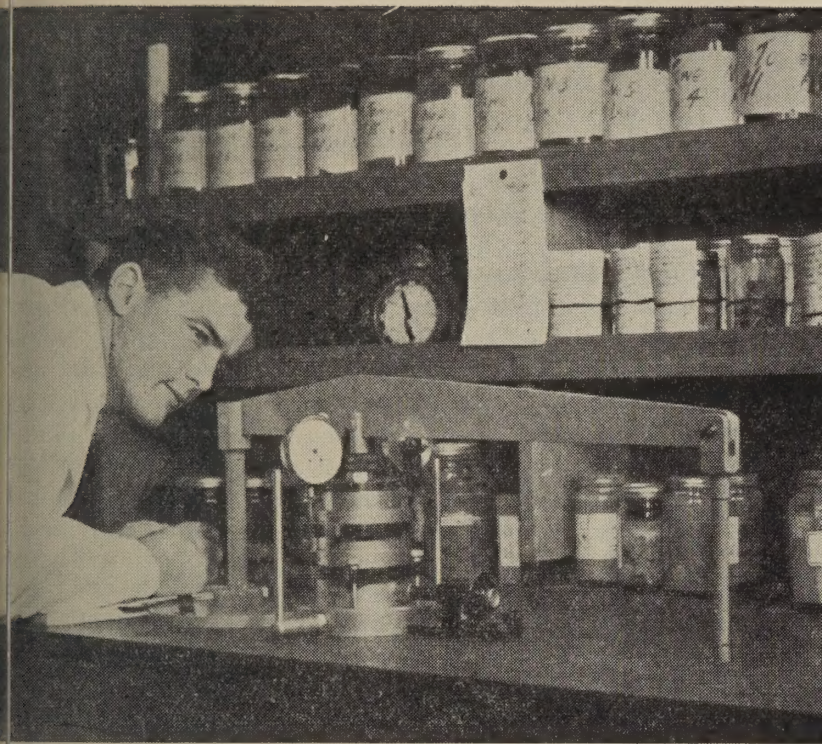
An investigation of special interest is that of soil corrosion. It has long been known that water- and gas-pipes corrode more rapidly when buried in some soils than in others. It is important, therefore, that we should know which are the corrosive soils, why they are corrosive, and what protective coatings should be applied to give the metal pipe the longest life. This work is done in co-operation with the Dominion Laboratory. The Soil Bureau is out to find out which are the corrosive soils and why they are corrosive, while the Dominion Laboratory carries out experiments on the best protective coatings.* Investigation has shown that New Zealand soils range from almost non-corrosive to strongly corrosive. Some soils corrode pipes because they are acid; others, although they are non-acid, corrode pipes because they contain large amounts of bacteria which form corrosive compounds.

Soil Physics Division

The study of soil physics, which began in a small way in 1911, is now an important part of the work of the Soil Bureau. The Soil Physics Division is divided into two sections, one dealing with agricultural physics and the other dealing with engineering physics, or soil mechanics as it is often called. The agricultural physics section is at present very small. It has done useful work in measuring the amounts of water which various soils will hold, how much of this water is available to plants, and the rate at which water drains through the soil. Work of this kind is particularly valuable in those areas which it is planned to irrigate. The physicists of the Soil Mechanics Division investigate the compressive strength of soil for engineering purposes. Soil to them does not mean more than the comparatively thin layer of soil under a garden. It means all the undisturbed sediments down to the bedrock. On plains and valley floors physicists may make investigations down to a hundred feet or more below the surface.

When a heavy weight such as a large building is placed on top of the soil, the soil gradually loses water and consolidates, causing the surface to settle. Some soils, notably peat, shrink much more than others during the process of consolidation. The architect, therefore, needs to know how much the surface is likely to settle down before he designs his building for a given settlement. If the settlement is excessive, the building may tilt and crack.

See *Post-Primary School Bulletin*, Vol. 1, No. 14, p. 215.



A. J. Metson.

the consolidation of soil under load. An "undisturbed sample" of soil is placed in the metal cylinder. Weights beneath the bench pull down on the soil. The settlement is recorded on the Ames dial.

One of the predicted settlements is interesting but exacting. Holes are drilled on the site of the proposed building, and the soil is prepared showing the different layers of soil. From these layers "undisturbed samples" are collected by a special sampler, which is forced into the ground under pressure. The sampler is a thin metal cylinder, something like a large needle. It is placed to receive the sample of soil. When the sampler is raised to the surface and opened, the metal cylinder containing the sample is closed with a lid and labelled. It can then be transported to the laboratory in approximately the same position as it existed in the ground. The soil physicist submits the sample to a range of pressures such as they will receive under the proposed building and measures the amount of settlement. From these results and the charts he has prepared of the soil, the physicist is able to work out how much settlement is to be

Other problems investigated by the Soil Physics include aerodrome foundations, the stability of deep cutts the material for earth dams.

Soil Biotics Division

The Soil Biotics Division is the smallest of our division is by no means the least valuable. As its name implies, to study soil life. The work of this Division is at present into two sections, one dealing with soil-plant relationships in the field and the other with pot testing for soil fertility. A section to study soil microbiology is also planned, but as no work has been done.

Some mention has already been made on page 38 of the relationship between soil and plant. Whenever a plant is grown in the soil, the growth of the plant is affected by the kind of soil and the formation of the soil is affected by the plant. Some studies have been carried out in North Auckland and in



Photo: A. J. Metson.

Testing soils in pots for trace element deficiencies. (The indicator is mustard.) Pot No. 1 has had no treatment. The other pots have had a dressing of nitrogen, phosphorus, and potash fertilizer. In addition, pots 3 to 8 have received various trace elements.

the effect that the native vegetation has had on soil. Work has also been done to show the changes that take place in the soil due to the planting of pine-trees over large areas. In these investigations the soil biologist works closely with the botanist and with the chemist who analyses forest litters. In order to compare the fertility of soils from widely different parts of New Zealand, large samples of soil are brought to the laboratory, where they are placed in pots and tested by various methods. Soils are tested in this way for trace elements, such as iron, zinc, and copper, since chemical methods of analysis for these trace elements are not very satisfactory. Plants are very sensitive to deficiencies of trace elements and show typical symptoms, such as mottling of the leaves, breaking of the tissues, or changes in plant form, when one of the elements is in short supply. An interesting experiment is now under way to test the efficiency of a fertilizer which is absorbed by a plant. Grass is being grown in pots containing soils that have been fertilized with phosphate made from radioactive phosphorus. The grass is taken up and analysed for phosphorus and is becoming radioactive. At the close of the experiment, by measuring the total amount of phosphorus in the grass and the proportion of it that is radioactive, we hope to know how much phosphorus has been extracted from the soil and how much from the added fertilizer.

Conclusion

A widespread belief that the Soil Bureau is organized to help individual farmers. This is not so. Extension work of this kind is carried out by the Department of Agriculture, and all farmers have free access to all Soil Bureau information. The work of the Soil Bureau covers a wide range of soil problems of New Zealand and covers all sections of the work need to be carefully co-ordinated. The solving of soil problems calls for team work. Nor does team work end inside the Bureau. Other departments, such as the Research Department and other departments of the Department of Agriculture, the State Forest Department, the Land and Survey Department, and the Public Works Department have all co-operated with the Soil Bureau at one time or another on some problem of common interest. The same co-operation is given by organizations outside the Government to individual farmers. The work of the Soil Bureau is to find out the facts of New Zealand's soil resources and to provide basic information on which others can build—a responsible task in a country where so much depends so largely on wealth won from the soil.



February 15

Last night I had a fair rest, but my back was too sore to sleep after 6:00. Just before 7:00 the maid brings me early morning tea -- a wonderful New Zealand institution.

Mr. Gibbs calls for me at 8:45 and we go to the Soil Bureau, where I wrap packages for sending to the United States. We then call briefly at the laboratory. Soil colors are being measured carefully with electrical apparatus according to soil standards and formulae developed in the United States Bureau of Standards. The apparatus seems quite interesting in itself, perhaps, but gives rather more refinement than is needed for examining disturbed soils in the laboratory.

I go on to post my mail and a package. Then I have morning tea with Dr. and Mrs. Grange at their home. After tea, I call on Mr. Foster, the American Agricultural Attache'. I give him a package for airmail and one for boat mail by pouch. Then I have lunch with Mr. and Mrs. Foster at their home.

After lunch, I go back to the hotel and pack my baggage. Mr. Gibbs takes me to the laboratory of the Soil Bureau and he plans to take my baggage on to the boat for Christchurch

later. I look around the laboratory hurriedly. There is work being done on the corrosion of metals, radio-active phosphorus, and manganese deficiency. I look at the general laboratories for soil analysis and talk for a while with the workers in the map drafting section.

Workers here are finding lime-induced chlorosis in peaches in the Hastings area that can be cured by sprays or by additions of sulphur to the soils. Through the radio-active phosphorus studies, they have shown that applications of phosphates on the phosphorus-deficient soils in the North Auckland area result in plants using much more of the phosphate already in the soil.

Relatively more chemical work seems to be done here to support the soil survey field work and interpretation than in most parts of the United States. Now they make only a few mechanical analyses.

Between 4:00 and 5:00 in the afternoon, I take a short walk and go to the barber. Then, from 5:00 to 6:00, I attend a cocktail party given by the American Ambassador. I have dinner with the others at the Midland Hotel, and at 7:30 p.m. we get on the boat -- the S. S. Rangatira -- for Lyttelton, the harbor for Christchurch.

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On the boat I am given my black-and-white pictures developed in Wellington. These are the ones taken in Australia and they are not very good. It looks like poor film.^{1/}

Certainly there is an unbelievable number of people on this little boat. It reminds me of the Ville d'Oran from Oran to Marseille in 1947.

I am early to bed.

^{1/} Added later: It was discovered later that most of the pictures were inferior from poor film.

TIONS

missions. Corrections of radio and airway
ould be marked on the face of the chart or
by observer in making the determination.
The user will materially assist in this

marked.

NSHIP

358 B
1: 500,000

358 C
: 500,000

AERONAUTICAL

AIRCRAFT FACI

AIRPORTS — COMPLETE FACILITIES Refueling
services, complete repairs, shelter, and (where appli-
cable) passenger or cargo services and/or seaplane
ramp with hauling-out facilities.

SEAPLANE LANDPLANE

- | | | |
|--|--|-------------------------------|
| | | Military Base |
| | | Civil |
| | | Joint Civil and Military Base |

LANDING GROUNDS and AN

- | | |
|--|---|
| | Landing Strip — Very limited or no facilities |
| | Landing Area — Very limited or no facilities or |
| | Sheltered Anchorage — Very limited or no facili |
| | Emergency Anchorage — Very limited or no fac |

AIRFIELD DAT

- | | |
|-----|---|
| 300 | Elevation in feet |
| L | Minimum lighting; obstruction, boundary or runway
and lighted wind indicator |
| H | Hard surface runway, normally all-weather |
| s | Normally sheltered take-off area |
| 60 | Length of longest runway to nearest hundred feet |

When specific information pertaining to landing facility data
is lacking, the respective character is replaced by a dash (-).

AIR NAVIGATION

Numerals in italics indicate elevation above

- | | | |
|--|---------------|-------|
| Rotating Light | ----- 110 ★ | Flash |
| Rotating Light (With flashing code lights) | ----- . . . ✱ | Obstr |
| Rotating Light (With course lights) | ----- .15 ✱ | Mari |
| Flashing Light | ----- ★ | Ligh |

- | | | | |
|-------------|-----------------|----------|-------|
| F—Fixed | Occ—Occulting | Gp—Group | W—Whi |
| Fl—Flashing | Alt—Alternating | R—Red | G—Gre |

Marine lights are white unless colors are indicated; alternating lights a

MISCELLANEOUS

- | | | |
|-----------------------------|-------|------|
| Mooring Mast | ----- | Visu |
| Dirigible Base | ----- | Town |
| Prominent Transmission Line | ----- | High |
| Lighted Obstruction | ----- | High |

Obstruction (Numerals in italics indicate elevation above sea level of obstruction)
Vertical numerals within parentheses indicate heights above ground
Ocean Station Vessel (Normal position)

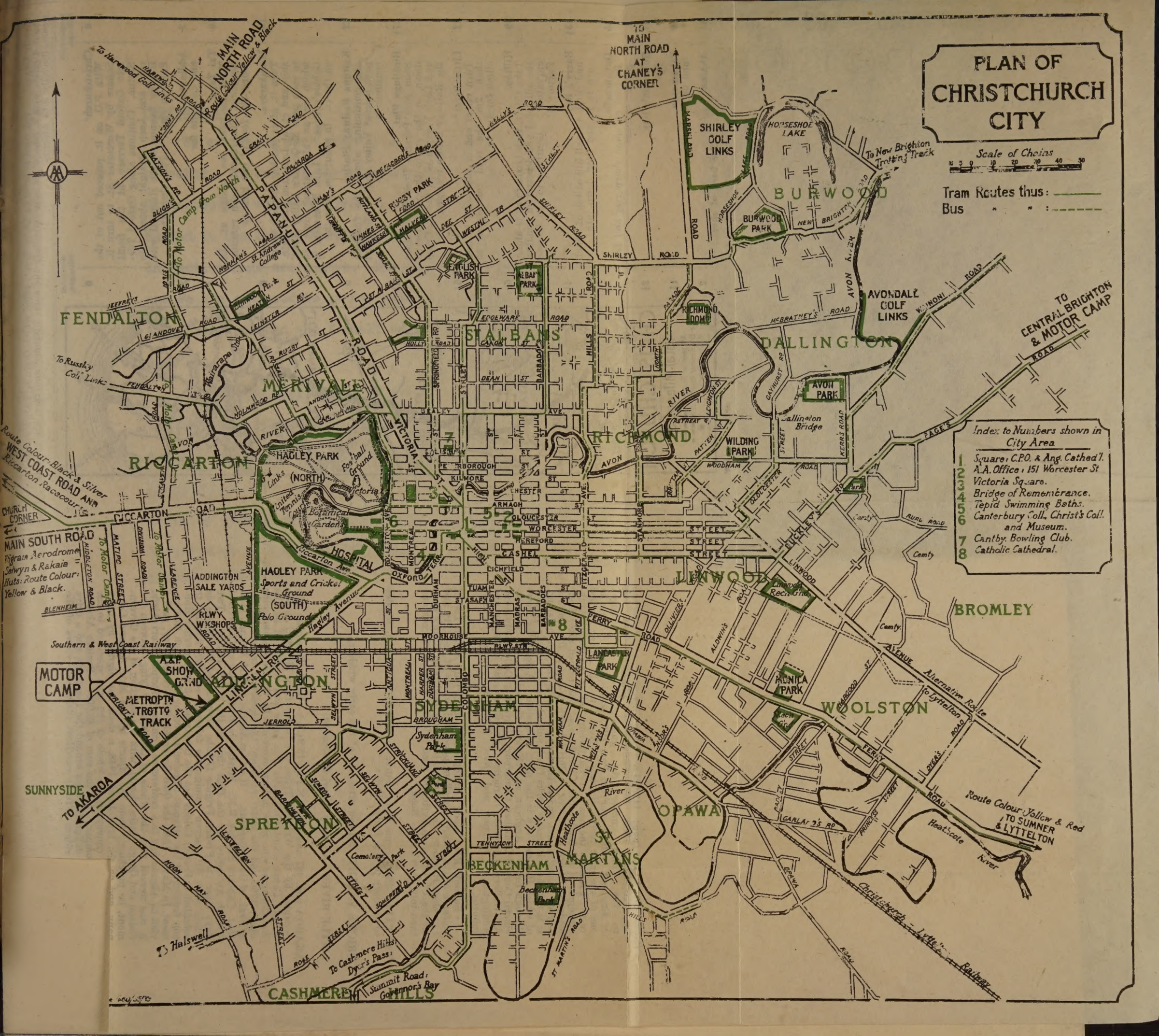
PLAN OF CHRISTCHURCH CITY

Scale of Chains
0 5 10 20 40 50

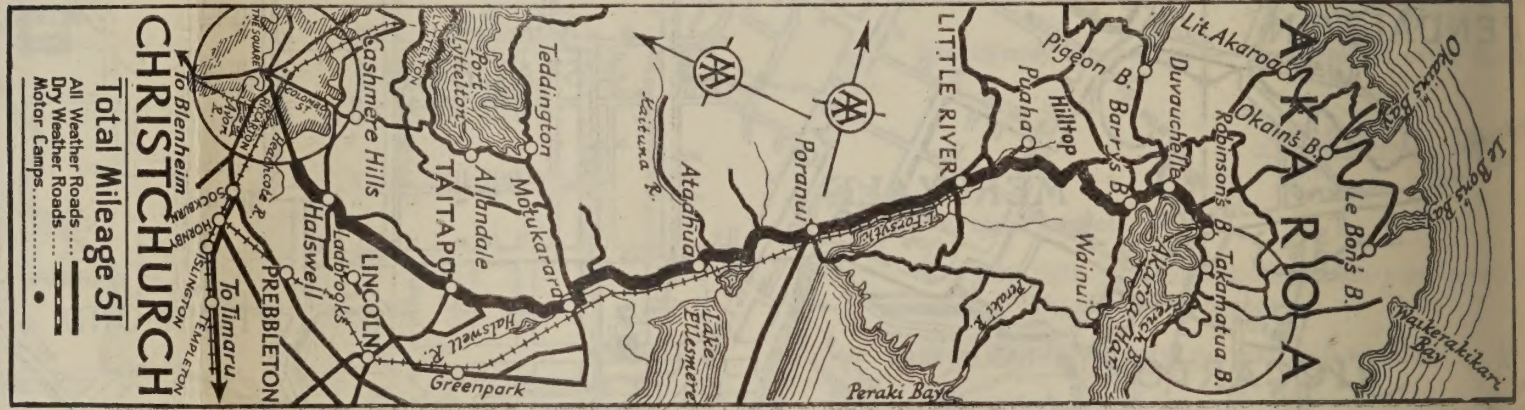
Tram Routes thus: ———
Bus " " : - - - -

Index to Numbers shown in
City Area

- 1 Square, C.P.O. & Ang. Cathed'l.
- 2 A.A. Office, 151 Worcester St
- 3 Victoria Square.
- 4 Bridge of Remembrance.
- 5 Tepid Swimming Baths.
- 6 Canterbury Coll., Christ's Coll.
and Museum.
- 7 Canterbury Bowling Club.
- 8 Catholic Cathedral.



0	Christchurch*	0
2	Addington and continue for	2
10	Tai Tapu*	8
16	Motukarara.	6
22	Kaituna Railway Station	6
27 1/2	Birdlings Flat.	5 1/2
33	Little River*	5 1/2
39	Hilltop.	6
43 1/2	Barry's Bay	4 1/2
45	Durauchelle.	1 1/2
47 1/2	Robinson's Bay	2 1/2
49	Takamatua	1 1/2
51	Akaroa*	2



CHRISTCHURCH. After arriving at Lyttelton in December, 1851, the Canterbury Pilgrims sent out to the Colony under the guidance of the Church of England, walked over the Port Hills to make their home in one of the most fertile districts in New Zealand. They applied to the Province the name of Canterbury, after the senior Archbishop of England while Christchurch was named after their leader's College at Oxford. Christchurch to-day is the English city of New Zealand, and is the largest city in the South Island. It is noted for its many parks (both publicly and privately owned) of which Hagley Park is the most extensive. Avon River flows through town. Anglican and Catholic Cathedrals, historic Provincial Council Chamber, Canterbury University College, Museum, Art Gallery and Public Gardens. Racecourses at Riccarton and Addington. Summer and New Brighton—popular seaside suburbs.

Summit Road along the top of the Port Hills which are of volcanic origin affords excellent panoramic views of the City and Lyttelton Harbour, etc. Access to it is gained from Evan's Pass on the Christchurch-Lyttelton road or from Colombo Street and then into Dyer's Pass Road.

TAI TAPU—Picturesque stone church erected by Sir Heaton Rhodes to memory of late Lady Rhodes.

PRICE'S VALLEY—Named after one of the early whalers.

LITTLE RIVER—An early Maori Settlement.

AKAROA. Banks Peninsula was occupied by the Waitaha Tribe who came from Hawaiki in the Arawa Canoe about 1500 A.D. This tribe was conquered by the Ngati-mamoe who were in turn overcome by the Ngati-tahu tribe about 1700 and the latter remained the dominant tribe until the arrival of the Europeans. It was at Akaroa on 11th August, 1840, that Captain Stanley, R.N., hoisted the British flag and exercised British Authority for the first time in the South Island. Two days later the French Frigate L'Aube arrived and the Comte de Paris with fifty seven immigrants followed on 16th August to establish a French Colony but the timely action of Governor Hobson frustrated the attempt of colonisation by the French Government. In March, 1848, the then Governor, Sir George Grey, paid a visit to Akaroa and in a conference with the principal Maori chiefs, it was agreed that the whole of the country lying between the Nelson and Otago blocks should, with the sanction of the Government, be purchased from the Maoris by the New Zealand Company, conveying the whole of the area specified to the company, for the sum of £2,000. Besides Akaroa and a drive ridges affords excellent panoramic views of the

February 16

We arrive in port about 6:45 a.m. after a good crossing. We are off the steamer and into the train for Christchurch, where we arrive a little after 7:30. I am booked in the United Service Hotel, but no room is ready. In fact, things are a mess. The baggage is all piled up, and we are supposed to go for meetings. The place appears to be very crowded and I shall need to share a room. Too bad.

I leave my bags and go as scheduled to a meeting of the Agricultural Research Planning Committee. A good report has been developed and probably will appear in the Proceedings. But when the report is presented in the Division meeting for agriculture, it is accepted along with an addition of a highly emotional statement on erosion. There is nothing wrong with this statement, although it is no more appropriate than a half dozen others would be on fertilizers, lime, drainage, and the like.

I prepare an amendment to the Forestry report that trees be considered in relation to agricultural crop rotations and erosion control, as well as in relation to saw timber. This is finally agreed to by the foresters after the words "woody plants" are substituted for the word "tree." The foresters

present will not accept the use of the word "tree" for a plant that cannot furnish salable timber.

After this meeting I hurry to lunch, get my room, and then come back for the sessions. This afternoon we have the first session on Soil Classification, of which I am chairman. The papers are given according to the outline in the program. The following is an outline of my remarks at this meeting.

I. Problems of Agriculture

- A. Production
- B. Conservation
- C. Living Standards
- D. Full employment

These mean full use of our soils on a sustained basis.

II. What is soil?

- A. Depth and area
- B. Genetic factors
- C. Landscape
- D. Dynamic

III. Soil classification: Since I've already said about all I could say now on great soil groups for the Proceedings of the Commonwealth Conference on Tropical Soils in Harpenden, and since the principles of the lower categories were set forth at the French conference in Montpellier, I shall deal here mainly with the soil units as a basis for prediction, as used in the United States.

- A. This year marks the 50th anniversary of the American Soil Survey, conducted cooperatively between the State Agricultural Experiment Stations and the U. S. Department of Agriculture.
- B. Original concept of soil series and type
- C. Present concept of soil series and type
- D. The soil phase
- E. The complex
- F. About 2000 soil maps have been issued -- but revisions are going forward as well as new surveys.

IV. Interpretation depends upon our knowledge:

- A. Scientific correlation: Need for morphological study in relation to genetic factors and mapping.
- B. Use of experimental research
 - 1. Laboratory
 - 2. Field plots
 - 3. Farms
- C. Analysis of existing experience
- D. Productivity ratings
 - 1. Yield estimates under specified management.
 - 2. Long-time effects of management on productivity.
- E. Soil groups
 - 1. By broad land-use classes (5 classes).
 - 2. By erosion hazard.
 - 3. By management requirements (most important). (Stress concept of ceiling response on highly responsive soils.)
 - 4. By crop adaptability.

F. Extension of predictions

1. Must recognize soil types.
2. Soil maps must have predictions to be useful.

G. Detail of soil surveys

1. Categorical -- level of knowledge and possible detail of predictions.
2. Cartographic -- depends upon possible uses.
3. Need for accuracy.

V. Cooperation

- A. Fundamental research
- B. Applied research
- C. Pilot research farms
- D. Unit demonstration farms
- E. Farm management service

In the question period we get into a discussion of world food problems and the orientation of farm advisory workers. Annett points out that in India he observed Laterite upon trap rock above 1200 feet and Regur at lower elevations on the same kind of rock. Pendleton's paper on Originality in soil classification is read by H. S. Gibbs. He fights windmills with a weak spear -- windmills about "temperate great soil groups." He warns against using these groups in the tropics. Everyone agrees, of course, since everyone is against sin.

After the session, I go back to the hotel, very tired for some reason. After my dinner, I am soon in a poor bed. I share the room with Dr. C. E. Pemberton from Hawaii. bination is not so good for me.

I go to the Soils program of the Congress, where I act as chairman. Professor G. W. Robinson gives an informal discussion of Soil Survey work in the United Kingdom. He says that "the general principles developed in the United States are now used in all civilized countries." Mr. J. E. Taylor does likewise for Australia.

Mr. W. H. Taylor describes the soil classification system used in New Zealand and makes a restrained but persuasive argument for the use of genetic names as well as the customary soil series names. He has developed genetic names for the soils in New Zealand in terms of degree of weathering, degree of leaching, and the degree of expression of pedogenetic processes like podzolization, solonchation, and gleyization. In his remarks Taylor emphasizes the contrast between continents and islands. In respect to New Zealand, he mentions the tectonic instability, including both volcanic and uplift, cyclic soil, hard forest, and the easily shifted vegetation. Of course, this discussion brings up the old argument between morphology and genetics. But as long as Taylor includes the

February 17

I am up early after a restless night. My roommate is a noisy sleeper, and since I am a light one, the combination is not so good for me.

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morphology, one can hardly object to his genetic names as supplements. Certainly it makes it much easier for informed people to understand the soils, their relationships to one another, and the relation of the soils to the environment.

After morning tea we have a general discussion of soil classification, based upon the papers of the last two sessions. Topics included:

(1) The relative use of genetics and morphology as bases for classification.

(2) The place of the laboratory in morphological work. It was pretty well agreed that the laboratory gives the morphologist additional tools.

(3) Relationship between soil types and plant associations. These relationships are closer in Australia where the landscapes are very old than in New Zealand where the soils are young.

(4) Mapping of erosion. Mr. Taylor of Australia regards erosion mapping as a very simple follow-up to the soil map. Dr. Grange and I regard the accurate mapping of erosion as much more difficult than Mr. Taylor indicates. We both insist that the erosion classes need to be specific by soil types. Mr. Taylor of Australia apparently agrees with this last point, but feels that men with only little training can do the work after the soil map is finished. I should not agree.

After lunch we go back to a program on land utilization. These papers will be printed.

J. W. Coulter's paper is read. In this he suggests "exclusive attention" to soil erosion at the next Pacific Science Congress! No one seems impressed.

Holt gives a paper on land classification for SCS purposes. In the beginning he says that H. H. Bennett began his work on soil erosion 40 years ago! (Of course he didn't.) He then reviews the establishment of the soil erosion experiment stations. He said that the SCS was organized to "use each acre according to its needs and according to its adapted use." This required, he said, the SCS to set up a miniature department of agriculture in order to bring in all aspects necessary for farm plans. Often 6 different specialists were necessary on one farm plan. But these large groups were criticized by farmers. So was born the land-use capability rating! According to Holt, it is "one of the greatest inventions ever made." The farm planner has everything he needs and yet it is very, very simple. He says such is not the case with "conventional" soil maps.

He then describes 8 classes of land that presumably include all things to be found in all parts of the world under all systems of farming.

Agricultural

1. No erosion problem.
2. Some erosion problem.
3. Serious erosion problem but can be tilled with protective measures.
4. Can be tilled with strict controls in long rotations, but best used for pastures and meadows.

Non-Cropping

5. No erosion but too stony for use.
6. Can be used for forest or pasture with some limitations.
7. Can be used for pasture or forest with very strict use regulations.
8. Should not be used for crops, grazing, or forests.

The definitions of the classes are given wholly in terms of erosion hazard, yet Mr. Holt insists that erosion is only one of the factors considered! No slight inkling is given of any other factor or how any other factor is taken into account. (Of course the grouping is based wholly on the supposed erosion hazard.)

F. A. Van Baren, Departement voor Landbouw and Visserij, Bodemkundig Instituut, Buitenzorg, Indonesia, gives a paper on Soil systematics in Indonesia. He attaches a great deal of importance to the mineralogical analysis of soils. As

presented, the classification is a kind of mixture of topography, mineralogy, type of weathering, and soil genetics. He deals with 10 kinds of mineral soils as follows:

1. Ash soils -- loams, silt loams, and so on.
2. Lateritic soils. He says these are most important. There are yellow, brown, and red kinds on many types of rock and with all ages. He says, for example, that a common one would be named "old red andesitic lateritic soil."
3. Margelitic soils. These have montmorillonite clay. They crack in the dry seasons, are gray to black in color, and are usually developed from marls. (These likely belong with the self-mulching black clays.)
4. Podsollic soils. These are found at all elevations on quartz-rich materials.
5. Limestone soils. These are deep red (or black, from soft rocks). A prominent clay mineral is halloysite. Most of these soils have been much affected by volcanic ash.
6. Quartz soils. These are confined to small areas of dune sand with 90 percent or more quartz.
7. Bleached soils. He says these are developed from acid volcanic products and have underlying clay horizons. The ground-water effects are unknown.
8. Mountain soils. These soils are found under wet and temperate conditions with humus accumulations. Some have been partly podzolized.
9. Marsh soils. These are hydrogenetic.
10. Sedimentary soils. These are young soils from marine or stream alluvials.

Soils having more than 60 percent organic matter are classified as peats (after Stokes).

After the remainder of the papers, I go to dinner and later spend the evening with Robinson discussing the outline and the chapters already prepared of the UNESCO-FAO bulletin, World food: problems and prospects.^{1/} Robinson gives me some good suggestions and general approval, which gives me more confidence in it than I have had.

^{1/} Changed to: Soil, food, and people.

SOIL SURVEY AND SOIL CLASSIFICATION IN NEW ZEALAND

By N. H. Taylor, Soil Bureau,
Department of Scientific and Industrial Research, N.Z.

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THE New Zealand Soil Survey as a branch of the Department of Scientific and Industrial Research was founded in 1930, although prior to that date surveys had been made by Aston for the Department of Agriculture, by Rigg for the Cawthron Institute, and by Ferrar for the Geological Survey.

SOIL SURVEYS

Soil surveys carried out are of three kinds--general surveys, district surveys, and detailed surveys.

The general surveys are designed as an aid to planning and are published on a scale of 4 miles to 1 inch. All roads are traversed by car, and sufficient foot traverses are made in the less accessible country to establish the major soil types and to gain reasonable knowledge of their distribution. From each type mapped, at least one pit sample is taken for chemical analysis. In the field, boundaries are sketched on any base maps available, and these are later compiled on to the Lands and Survey 4-mile map for reproduction. An extended legend to be published with each survey contains the following information entered against each soil type in column form: classification, parent rock, topography, vegetation, rainfall, soil profile, chemical analysis, natural fertility, present uses, probable best uses, present and potential carrying capacity, response to fertilizers, and state of erosion. In addition, notes record such data as the distribution of the type, the standard of farming, problems of weed control, drainage, water supply, etc. The agricultural data are collected in cooperation with extension officers of the Department of Agriculture.

The district surveys aim to show the soil pattern in sufficient detail to allow of a study of the soil problems arising from land use practices and to aid in the spread of soil knowledge to the user of the land. The field sheets used are the inch to the mile topographic series of the Lands and Survey Department. The publication scale of 2 miles to the inch has been chosen in preference to the more usual scale of 1 mile to the inch because it speeds up field work by suppressing minor detail which more properly belongs to detailed surveys where on a larger scale the detail can be better and more usefully shown in relation to holdings, boundaries, and farm subdivision.

The detailed surveys are virtually farm to farm surveys showing the soil pattern in relation to subdivisional boundaries. These are the type of surveys which will ultimately be made of all our intensively used land. Not only are they an excellent aid to extension work, but they also form a valuable basis for many fields of research. By showing such details as the name of the farmer, the house he lives in, his farm buildings, his fences, drains, and plantations, they help to bring the factor "man" into his rightful place in soil studies. With the aid of aerial maps, the carrying out of such surveys over relatively large areas is now practicable. The standard scale for the publication of these surveys is 40 chains to the inch, but the scale is necessarily modified to suit special conditions.

The following table shows the state of soil surveys at the present time. (The approximate area of New Zealand is 103,000 square miles):

	<u>General Surveys</u>	<u>District Surveys</u>	<u>Detailed Surveys</u>
North Island	43,866 sq.m.	11,164 sq.m.	3,920 sq.m.
South Island	51,029 sq.m.	8,408 sq.m.*	1,343 sq.m.*
Totals for New Zealand	94,895 sq.m.	19,572 sq.m.	5,263 sq.m.

*1,992 sq.m. of district surveys and 156 sq.m. of detailed surveys have been carried out by the Cawthron Institute.

SOIL CLASSIFICATION

In New Zealand we are still feeling our way towards a system of classification that will satisfy our needs. At present we are classifying our soils in various ways according to the purpose for which the soil grouping is made. These may be discussed under two headings--the empiric, depending upon profile characteristics alone; and the genetic, depending upon an interpretation of these characteristics in terms of the soil forming processes.

Empiric Method

Soils are named and mapped to aid land-use, and the needs of those using the land dictate to a large extent what soil units and subunits are to be established. In establishing and naming the soil unit--the soil type--the American method is adopted. The type is established from a study of the profile and observations and deductions checked by a consideration of the soil-forming factors and manifestations of response to land-use. The type is designated by a geographical name followed by a textual name which indicates the texture of the topsoil.

Types may be subdivided into subtypes and phases. Subtypes are based and named according to minor differences in the profile; e.g., type, Whakapara loam; subtype, Whakapara mottled loam. Phases are differences of a smaller order and are usually mapped to meet the requirements of some special land-use. They are named either with reference to the profile or with reference to some soil-forming factor; e.g., Oxford silt loam; strongly rolling phase.

Very closely related types bear the same geographic name and so belong to the same series, but little significance is attached to the series as a grouping. It is used more as a practical expedient to save the unnecessary multiplication of geographical names. Since the units mapped are largely dictated by the needs of land use, there is likely to be a smaller order of difference between series in a district under arable farming than in a district under permanent pasture.

Where the soil pattern is too detailed for the scale of the map, complexes are established. Following American usage, the types making up the complex are recognized. A particular kind of complex is the "soil mosaic" due to vegetation. The best examples are seen where a forest mosaic of mull and mor-forming trees has etched its pattern on the soil, producing a mosaic of yellow-brown and podzolized yellow-brown earths.

Seven slope categories are recognized in detailed work, but for most surveys four are found to be sufficient--flat, rolling (most slopes under 12°), moderately steep or hilly (many slopes between 12° and 30°), and steep (many slopes over 30°). Although profiles are different, types on hilly land are not generally given separate geographic names, but are

considered as hill soils related to types situated on rolling or on steep slopes. This not only effects a saving in names, but also helps to preserve the strong relationship that exists throughout the topographic soil sequence.

For the purposes of any particular survey, the units are classified in any way likely to best satisfy the requirements of the user of the survey. Types and series may be grouped into the equivalent of the American families or according to sequences. As yet, however, there has been no attempt to carry the empiric classification logically into the higher groupings.

Genetic Method

Useful as empiric classification is for certain practical purposes, it is disappointing and even misleading when used in many research projects. This after all is not unexpected, for experience in other sciences has shown that real progress cannot be made until the empirical stage has been outlived and a genetic classification has been evolved.

The most fundamental maxim of pedology is that the soil is a dynamic, not a static body. Hence a sound classification should not tend to divorce the soil process from the soil. The processes that have operated in the past and those operating today should be the very essence of the classification. In New Zealand, the need for a more dynamic method of classification is strongly felt, as so few of our soils seem to be perfectly in balance within their environment. The climatic range is not inconsiderable, and rock, topography, and vegetation types are varied. All this within the compass of our small country naturally leads to relatively small areas of satisfactory types with abnormally large areas of transitions.

It may be true, as Jenny states, that in order to be perfect, soil classification should be five-dimensional, but other sciences have been faced with similar difficulties and have overcome them. Geomorphology, for instance, is a science that has made great advances since it adopted a genetic method of classification. Its classification, based on a consideration of the process operating, the structure acted upon, and the stage to which the process has operated, is a close parallel to what pedologists are attempting in their genetic systems. Both attempt to classify the products of several formative factors. Both simplify the problem by combining the effect of several factors into a process, and both subdivide on the stage to which the process has advanced.

New Zealand workers are far from having evolved a satisfactory genetic system, but they have attempted to produce a system that meets their needs.

As the emphasis is on soil-forming processes, Marbut's "fundamental point of view regarding soil classification" has been reversed to read: Soils should be classified upon soil-forming processes as evidenced in the profile, not upon certain chosen profile characteristics.

Before such a classification can be perfected, soil processes need close study. We have not yet been able to do this, and have been forced to rely in the meantime upon a simple analysis of the pedologic process as it appears to operate in New Zealand soils. The pedologic process is regarded as consisting of three parts--(i) soil wasting, (ii) the organic cycle, and (iii) the inorganic cycle--which we may pause to briefly describe.

- (i) Soil wasting is but part of the greater geologic cycle of rock weathering and rock-building. It depends largely on the one-way movement of water which, were the crust stable,

would reduce the solum to a pedologic peneplain. It may be divided into rock breaking, rock decay, leaching, eluviation, and panning. Soil weathering is defined as the decay of the mineral skeleton of the soil, of which such processes as gleying and gammation are considered to be special kinds.

- (ii) The organic cycle is evidenced in the struggle of soil life to maintain the fertility of the soil against the wasting effect of the downward movement of water. Its effects may be divided into the mixing of soil by organisms, melanization, and the conditioning of soil wasting, of which podzolization is an outstanding example. Recognition of the difference between soil weathering and the conditioning of soil weathering by the organic cycle is essential, for one process can be well out of step with the other. Failure to recognize this has led to fallacious reasoning concerning the degrading and regrading of soils under a forest cover.
- (iii) The inorganic cycle is the accumulation and removal of soil material by inorganic agencies. It includes accumulation (addition of matter to the soil surface by flooding, air-borne dust and cyclic salt), mixing (by soil creep, slipping, and frost heave), and flushing (the introduction of water and dissolved elements below the soil surface.) The effects of the inorganic cycle are best seen in the azonal soils.

In setting out the classification, certain soil groups are named--groups within which we see evidence of a uniform type of soil-forming process. Appropriate qualifying words are chosen from the above simple analysis to denote stages in the process. This classification is illustrated in abbreviated form on the accompanying map, where, for example, the yellow-brown earth, a "podzolic" zonal group of the humid districts, is subdivided on degree of soil weathering and further subdivided on degree of leaching.

On some surveys we have classified the yellow-brown earths and podzolized yellow-brown earths together in a "podzolic sequence" and divided on stages of maturity commencing with a weakly leached, yellow-brown earth, and ending with a strongly podzolized one. This has proved a useful conception, as many land-use problems follow the easily comprehended trend of the soil properties throughout the sequence.

A refinement of this sequence is the soil suite. Milne's condemnation of Robinson's suite could only have been due to insufficient experience with this soil grouping. It is the only grouping that allows of the separation of acquired and inherited soil characteristics, and hence is invaluable in many problems of applied pedology.

There are many weaknesses in our classification:

- (i) It does not really classify the type as mapped, but only the type profile.
- (ii) It is unstable in that it must alter as knowledge increases. This, however, need not lead to undue confusion, for the units, the soil types, will remain the same, and since alterations cannot be accepted without evidence, it will stimulate inquiry into soil processes.
- (iii) Cumbersome colour names such as yellow-brown earths are not satisfactory. More words like "podzol" and "gley" are needed--words that can be used for both soil and process, and that can be readily converted to nouns, adjectives, or verbs. They must, however, be clearly defined and restricted

in their meaning. (Pendleton has put up a strong case for the restriction of the term "laterite." A stronger case could be put up for "podzol" and "podzolized.")

- (iv) Too many of our qualifying adjectives end in "ed" instead of "ing." Everywhere the soils are changing, but so far we have attempted to classify them only as they were at the time of European occupation. The soils of all our good dairying lands show signs of a common process that is bringing their profiles closer together. We need words to express these changes clearly and should not be satisfied with words that merely relate to something which has happened in the past.

A pedologist's main job is not merely to map and classify soils, but to study them and understand their problems. He should be able to classify any of his profiles in an understanding and helpful manner if he is to maintain his position as the equal and not become the unworthy servant of the agriculturalist, the forester, and the engineer.

REFERENCES

Jenny, H. Arrangement of Soil Series and Types according to Functions of Soil Forming Factors. Soil Science, 1946, p. 389.

Marbut, C. F. Life and Work of Marbut. p. 143.

Milne, G. Some Suggested Units of Classification and Mapping. Soil Research, 1935, p. 194.

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LAND CLASSIFICATION, NEW ZEALAND

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THE adoption of varied systems of land classification is due to the unequal emphasis which workers have placed on the physical, social, or economic factors which are involved in the formulation of definitions of land classes. Diversity of definition is a reflection of diversity of purpose. Farmers, land valuers, and administrators require land classification, and economists, agronomists, agrostologists, pedologists, foresters, engineers, and sociologists desire to assist in the task of land classification--each with a purpose which may vary the emphasis on the physical, economic, and social aspects. Hence the adoption of such diverse criteria as general plant growth, yield of particular crops, investment and condition of permanent improvements, farm management practices, labour-income, etc.

The background purpose of the work of classifying land should be to enable the people of the country to make the best use of the land: in short, to give help or direction to the adoption of farming systems and forestry programmes which improve, or at least conserve, soil fertility and are economically and socially desirable.

Methods of Land Classification employed to date

The land classification surveys already made fall roughly into two categories: (a) those that deal with the present utilization of the land, and (b) those that classify according to its suitability for various uses.

The chief present utilization surveys are briefly described below:

- (1) Following a soil survey, Fleming⁽¹⁾ divided the soils of Ashburton County into eight groups, these providing for the various kinds of farming--store sheep, sheep, sheep and wheat, fat lamb and wheat, mixed cropping and sheep, mixed cropping, sheep, and dairying, etc. As well, figures were given of present carrying capacity for cattle and sheep, average yields of wheat, and suggestions for improvement of the farming in the groups.
- (2) Rigg⁽²⁾ has described the systems of farming in Waimea County, finding that they relate closely to soil types.
- (3) Hill⁽³⁾, in the Mid-Hawkes Bay Bulletin, gives information in relation to soil types on the composition of the pasture, erosion, topdressing required, and the crops that are suitable.
- (4) Connell⁽⁴⁾ and the Department of Agriculture⁽⁵⁾ have published small-scale maps of the North and South Islands, showing the distribution of the main systems of farming--dairying, fat lamb farming, extensive pastoral, arable-mixed farming, orchards, etc., and undeveloped land.

carrying, fat lamb farming, extensive pastoral, arable-
mixed farming, orchards, etc., and undeveloped land.

Surveys according to suitability for various uses include:

- (1) Connell, Elliott, Atkinson, and Hyde⁽⁶⁾ grouped the soils of Heretaunga Plains on the basis of suitability for (a) farm crops, (b) fruitgrowing, and (c) market-garden crops. The map of farm crops gives a guide for the main crops as to location of soil types that are unsuitable, suitable, and grow best. The legend for orchards classifies soils as first-class, second-class, third-class, and unsuitable for orchards.
- (2) In this category may be mentioned Hamilton's survey in the Whangarei County, as it leads directly to a suitability classification. Using a soil map, a holdings map, and farm statistics, he compiled maps (unpublished) showing for the soil types average sheep-carrying capacity and butterfat returns, and similar information, for the best 10 per cent of the farmers. Besides other uses, such data are of value in judging the suitability of a soil type for these types of farming.
- (3) In four cases, single crops have been studied in relation to soil types. Burns and Taylor⁽⁷⁾ reported on the quality of soils of North Auckland for the growing of the tung oil tree. Taylor, Hamilton, and Paynter (unpublished) evaluated the soils of North Auckland, Auckland, Bay of Plenty, and Gisborne for their suitability for the growing of citrus fruit. Greenall, Faithful, and Wright⁽⁸⁾ classed the soils of South Otago and Southland, and Raeside and Mason⁽⁹⁾ the soils of Geraldine County for the growing of linen flax, relating quality and yield mainly to the moisture content of soil types during the early part of the growing season. Rigg has drawn a detailed map (unpublished) of the tobacco soils of the Motueka district, Nelson, naming them first-class, second-class, and third-class.
- (4) Another kind is Raeside and others' account and map (unpublished) of Maniototo Plains, in which soils are classified according to their suitability for irrigation. Using the map, officers of the Department of Agriculture will recommend types of farming under irrigation.

The above are sufficient to show the trend in land classification methods in New Zealand. It is surprising to find that about as much work has been done on suitability surveys as on actual use surveys. As the actual is a stage in assessing suitability, one would have expected efforts to predominate in this direction. Of the suitability surveys, the most thorough is that of the Heretaunga Plains, and of the actual, that of Ashburton County. All provide a background of information for the consideration of a comprehensive legend, and will assist in the field work connected with it.

Land Classification for New Zealand

A scheme of land classification by Cumberland⁽¹⁰⁾ is the only comprehensive one proposed for New Zealand. It is the unit area method which has been applied by Hudson⁽¹¹⁾ in the Tennessee Valley, U.S.A. The notations for the numerous properties of the land lead to a final classification which shows whether land is unsuitable for agriculture, and the degrees of suitability of the remainder for agriculture. It does not allow adequately for the potential value of the land, and lays too much emphasis on the state of farm buildings, etc., to be applicable to New Zealand. An advantage claimed for the method is that field personnel need little training—rather this is a serious weakness unless the leaders know intimately the conditions required for each kind of land use.

Grange⁽¹²⁾ emphasises that soil mapping must proceed well in advance of land classification. He groups North Island soils according to their fertility or potential production in relation to pasture, and adds that surveys on the basis of the soil types should be made of present use, followed by surveys to show all the uses to which a soil can be put.

The basis of classification would appear to be found in the systems of farming and forestry which the major factors of soil and climatic conditions impose. These are a reflection of the plants which the soil will produce, and which may be converted into marketable products. On this basis, the first very broad divisions are forest lands, pastoral lands (including the crops associated with pastoral lands), horticulture and special crop lands, and arable lands, each of which is capable of numerous subdivisions and combinations. Such land divisions based on plant production should present to workers in all fields of farming and forestry the background necessary for more specialized study of the physical social, or economic factors which may affect the pattern of land use.

In New Zealand, it has been plants which have dominated our thoughts on land classification. In the early days of settlement, it was the natural plant covering. We divided the land into bush (forest), scrub, tussock, and swamp land, and each main class was subdivided into further classes by the predominant species as a measure of fertility. With the development of farming, this measure passed to the plants sown to replace the natural vegetation, and as physical and economic factors caused the country to adopt pastoral farming, pasture plants became our index of fertility and intensity of farming.

There are, then, the three divisions mentioned above, and a fourth--unproductive--is needed, viz:

- (1) Forest
- (2) Pastoral
- (3) Horticulture and special crops
- (4) Unproductive

The writers have attempted to subdivide (2) Pastoral, which is the most important group for New Zealand, seeing that, of the total area (66 million acres), as much as $31\frac{1}{2}$ million acres are in pasture. Moreover, it is probably the most difficult to classify. The scheme adopted is set out below:

Pastoral and Potential Pastoral

<u>Use</u>	<u>Chief Pasture Characteristic</u>	<u>Topography</u>
Meat and Milk	(1) Water grasses	Flat: subject to periodical flooding
	(2) Strawberry clover	Flat: reclaimed tidal
	(3) White clover permanent	Flat and undulating
	(4) White clover permanent when land is topdressed and/or irrigated or drained	Flat and undulating
Meat	(5) White clover permanent, but not vigorous	Hilly and steep
	(6) White clover permanent only if topdressed and improvement works more costly than (4) owing to topography (a) or special soil conditions (b)	(a) Elevated, flat and rolling or hilly or steep (b) Flat and rolling

<u>Use</u>	<u>Chief Pasture Characteristic</u>	<u>Topography</u>
	(7) White clover lasts only three to five years with or without topdressing	
	(a) Subterranean clover with topdressing	Hilly and steep
	(b) Low yields of annual crops and subterranean more suitable than white clover	Flat and rolling
	(c) Medium yields of annual crops	Flat and rolling
	(d) High yields of annual crops	Flat and rolling
Meat + store stock and wool	(8) Annual grasses and trefoils	Flat
Store stock and wool	(9) Clovers absent and topdressing not feasible	
	(a) Danthonia-browntop (i) with no erosion, (ii) with erosion	Hilly and steep
	(b) Native pastures (1) with no erosion, (ii) with erosion	
Wool	(10) Native pastures	Mountainous

It will be noted that clovers and other legumes are almost entirely the determining factors for the subdivision into nine classes. Alongside these is recorded the uses to which the land can be put. Horticulture, covering in total a small area, most likely does not need subdividing to fit in with the broad picture of pastoral land. A classification of forest land is required, and this can be left to the forester.

It is clear that most soil types will be marked as suitable for more than one purpose. A soil may in some cases be suitable for forest, pasture, and horticulture. This should appeal to the forester: too often the method is to find out what land is fitted for agriculture and leave him the balance.

A detailed split-up can arise from the broad pastoral subdivisions--yields of butterfat, carrying capacity, economic returns according to market price, etc. Horticulture can be divided to treat each crop separately and collect information on yields, costs, etc. The forester may be able to compare rates of tree growth on soil types and give the expected yields to compare timber returns with those of agriculture. All these follow naturally if the broad divisions are correctly based.

To make a detailed classification, it is necessary to utilize five major projects:

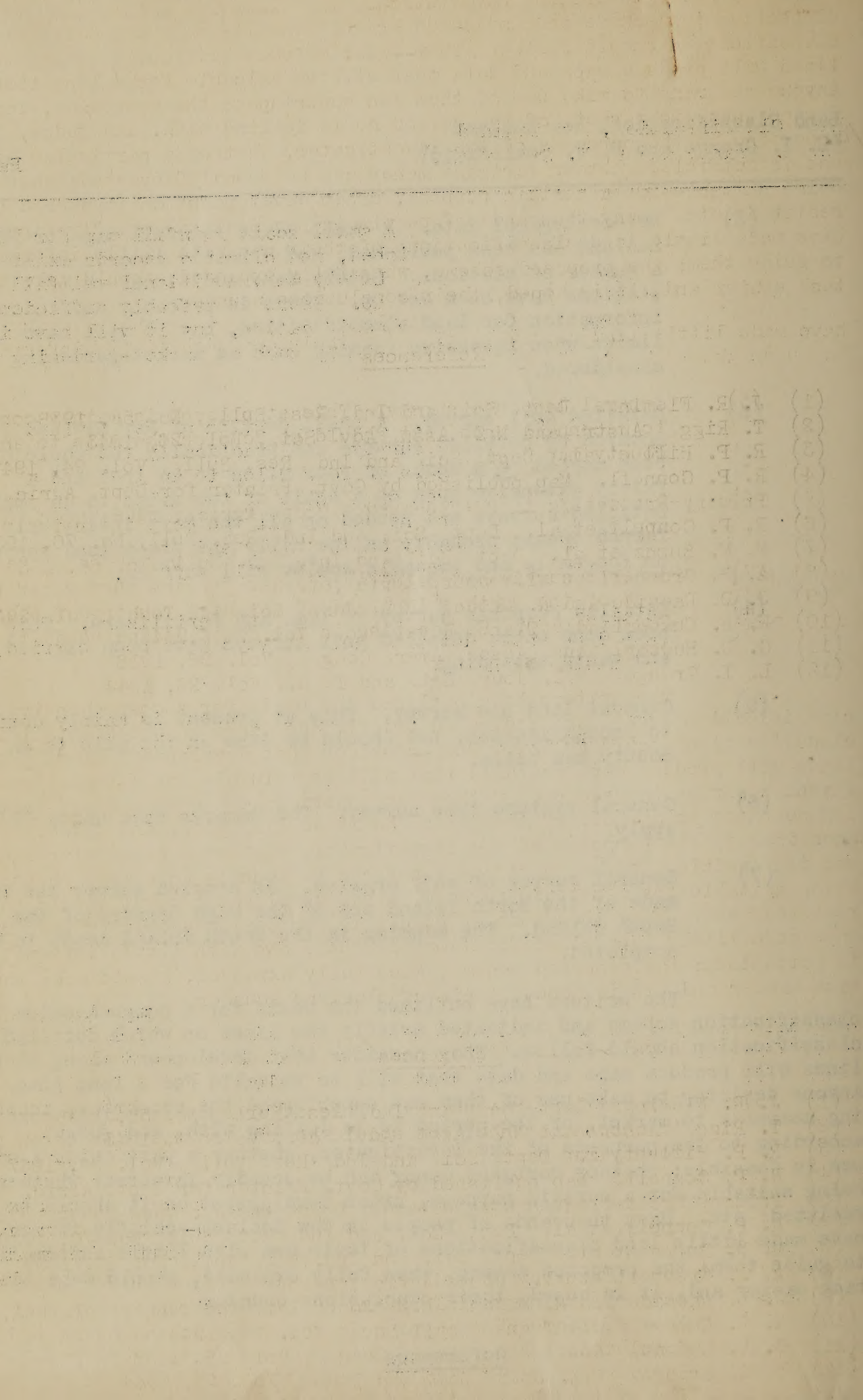
- (1) Topographical survey. Air photos on scales adequate for detailed mapping are available for much more than half the North Island and less than half of the South Island. Topographical maps on a scale one mile to an inch have been published of about half of both islands, these mostly following the distribution of air photos. The maps cover the main areas of flat and rolling country. Both air photos and topographic maps should be completed.

- (2) Meteorological data. A small scale rainfall map for New Zealand has been published, and climatic records exist for a number of stations. Lately many additional rainfall stations have been set up. There is probably sufficient information for land classification, but it will have its limits when intensive farming such as market-gardening is considered.
- (3) Detailed soil survey. A small portion of New Zealand is covered by detailed surveys and practically the whole has been mapped on a scale of four miles to an inch and a fairly extensive area on a scale of two miles to an inch. Detailed surveys are needed on all the more intensively farmed areas; probably on the hilly and steep land surveys on four-mile and two-mile scales will suffice.
- (4) Detailed response survey to lime and fertilizers. This has been done where detailed soil surveys have been carried out, and wants extending.
- (5) General land use survey. This at present is mainly confined to reconnaissance, but should be done on the mile to an inch county map basis.
- (6) General pasture type survey. The remarks made under (5) apply.
- (7) General survey of soil erosion. An erosion survey has been made of the North Island and of the high country of the South Island. The mapping in the South Island needs to be completed.

The writers have outlined the basis for a comprehensive land classification scheme and indicated briefly the lines on which detailed classification should follow. They consider that development along these lines will produce maps and data that will be valuable for a long time. Anyone desiring to make use of them can superimpose the economics, including nearness to market, of the period he is dealing with, and judge, according to the purposes of the investigator, whether a particular land use is feasible; whether mortgage money can be soundly invested; whether, being suitable for a certain purpose, urban development on it should be resisted; etc. Many thousands of people in New Zealand--chiefly farmers--have made little land classifications of their own with little information to guide them: the proposed scheme, when fully expanded, should make their task easier and, it is hoped, their conclusions sounder.

References

- (1) J. R. Fleming. Dept. Sci. and Ind. Res. Bull., No. 58, 1938
- (2) T. Rigg. Austr. and N.Z. Assn. Adv. Sci., Vol. 26, 1943
- (3) R. P. Hill et al. Dept. Sci. and Ind. Res. Bull., Vol. 94, 1947
- (4) R. P. Connell. Map published by Govt. Printer for Dept. Agric.
- (5) Primary Production in New Zealand. Dept. Agric., 1948
- (6) R. P. Connell et al. Dept. Sci. and Ind. Res. Bull., No. 70, 1939
- (7) M. M. Burns et al. Dept. Sci. and Ind. Res. Bull., No. 66, 1939
- (8) A. F. Greenall et al. Jour. Agric., 1943
- (9) J. D. Raeside and R. Mason. N.Z. Jour. Sci. and Tech., Vol. 28A, 1946
- (10) K. B. Cumberland. Trans. Royal Soc., Vol. 74, 1944
- (11) G. D. Hudson. Ann. Assoc. Amer. Geogr., Vol. 26, 1936
- (12) L. I. Grange. N.Z. Jour. Sci. and Tech., Vol. 26, 1944



February 18

After breakfast, I go to the sessions on Land Utilization according to the program. Mr. J. K. Taylor of Australia says their work is done in 4 steps.

1. Broad soil groupings.
2. Soil associations.
3. Detailed soil survey.
4. Land utilization.

He says that the agricultural possibilities of northern Australia, west of Queensland, have been greatly exaggerated by popular writers.

Grange and Smallfield give examples of many useful interpretations of the Soil Survey in New Zealand for specific crops and for single interpretations, such as lime needs, fertility, erosion hazard, irrigation potentiality, and the like. Obviously, the pasture lands get the greatest emphasis. Of the total acres, around 66 million, as much as $31\frac{1}{2}$ million are in pasture. A large part of this is sown after plowing, some is surface sown, and some is native grassland, including "tussock" land. Over 4 million acres are top-dressed annually with phosphatic fertilizers. Many soils need lime, but the quantities vary a good deal.

Mr. W. M. Hamilton gives an excellent paper on Farm surveys as a basis for land classification. This is the best one in the Land Utilization Section. In this paper Hamilton describes an investigation of Whangarei County in which the land use and productivity of all the farms were determined and related to the type of soil, so that he was able to arrive at the carrying capacity in stock units for each kind of soil. He was able to establish bench marks to be used in advisory work with farmers, showing the practical goals they could expect to reach.

At the close of the session, the Chairman asks me to comment on the program. I try to emphasize the need for basing the land classification on the characteristics of the land and to avoid mixing administrative and economic considerations in the classification and identification of the fundamental units. If this is done, then any change in economic conditions or in program requires that all the field work be done over again. If the physical facts are kept separate, reinterpretations can be made from time to time from the original field maps.

At the same time, we must realize that the administrative considerations are important in the final land classification. Many of these are not within the field of competence of the

soil scientists. In developing the final classification, the soil scientists shall need to cooperate with economists and others. I illustrate with brief descriptions of land classification for irrigation, use-suitability groupings for settlement, land classification for tax appraisal, land classification for credit assessment, and land classification for the use of agricultural extension agents or advisors.

The question arises about land classification in areas not having a soil survey. Stewart of Western Australia suggests the use of vegetation, since it integrates climate and soil. But, of course, this is extremely dangerous unless the correlations with the soil have been thoroughly established. There is something more said about erosion surveys, but nothing of importance. This whole discussion is a bit foggy. I leave a bit early to give a short statement about the work of the Agricultural Division of the Congress for the New Zealand wireless.

After lunch, I "cut" a garden party in order to check my air reservations, to rest a bit, and to prepare a wireless address for next Monday.



PEGASUS BAY

South Island Motor Union
151 Worcester Street
Christchurch.

A. A. Canterbury
Office & Club Rooms
151 Worcester Street
Christchurch.

BANKS PENINSULA

REFERENCE

- Main Roads
- Other Roads
- Fords
- Outlying Petrol Stations
- Motor Camps
- Railways
- Mileages
- Aeroplanes Landing Grounds

Scale of Miles
0 1 2 3 4 5 6 7 8 9 10 11 12

February 19

I am up early for some more work on the wireless address. At 9:15 a.m., I leave the hotel with N. H. Taylor, J. P. Fox, W. A. Pullar, and E. J. Cutler for a trip north and west of Christchurch. The morning is cool, but bright and sunny.

We go north over smooth, slightly imperfectly drained terraces. The soils have a complex of surface textures and are underlain by coarse gravels at 6 inches to 12 feet. Near the city, farms are intensely developed for the local milk supply. I see some fields of good red clover, mainly for seed.

We pass Kaiapoi and drive through a small area of low, fixed, sand dunes, and then onto slightly imperfectly drained alluvials. I see potatoes, baled hay, wheat, alfalfa, peas, a few vegetable gardens, and much pasture and hay.

A little south of Rangiora we turn west. Some individual fields are weedy from poor management -- overgrazing and failure to mow. There is an enormous contrast from farm to farm in the skill for handling the weed problem. Paddocks free of weeds and paddocks foul with weeds are often seen side by side. There are many low hedges and some clumps of

planted trees, especially near the farmsteads. I see a few fields of rape for pasturing lambs.

West of Rangiora, the soil is better drained and the gravels are nearer the surface. To the north and north-west, I see bold, broken, low mountains, some of which have a poor cover. Many of the upper slopes have prominent scars that look like slips. Here the land is undulating, with relatively dry, gray, gravelly surface soils (Templeton series), used mostly for hay and pasture, with some cereals and a little rape. A few fields are in fallow. The most important production here is wool and fat lambs.

Nine miles west of Rangiora we enter an area of "downs" -- gently rolling uplands. We turn south a little beyond Springbank. Here there are dairy cattle as well as sheep, and some wheat. The country is fairly open except for low shrubby hedges and small clumps of trees.

After a mile and a half, we turn west and in one mile stop to look at the soil in a road cut on the margin of this gently rolling area with nearly level terraces lying below us to the west.

The soil is said to be the Mairaki series -- a "yellow-grey earth." There likely is some wind-blown material mixed

in the upper part -- material blown up from the old alluvial deposits. The surface here has been somewhat disturbed.

- | | | |
|----------------------------------|---------|---|
| A ₁₀ | 0-2½" | Grayish-brown (10YR 5/2) light silt loam. Softly and finely granular, held by grass roots. |
| A ₁₁ | 2½-6½" | Like the above, but less roots and slightly more compact. |
| A ₃ | 6½-14" | Mottled grayish-brown and pale yellow, with some light gray and yellow, fairly compact silt loam. |
| BG ₁ | 14-20" | Very pale brown (10YR 8/3) and light gray mottled with reddish-yellow, compact silt loam. Vesicular. Massive in place, but digs out in irregular, angular chunks that are friable under very hard pressure. Only a few cracks in place. Occasionally there are bands with rather dense reddish-yellow mottling. |
| B ₃ -C-G ₂ | 20-48" | Pale brown (10YR 6/3), fairly compact, highly vesicular silt loam. Somewhat more friable than above. Irregular breakage. Roots penetrate throughout, but are unevenly distributed. They are flattened against the cleavage planes. |
| D | 48-50"+ | Mottled brown and yellowish-brown, massive, compact, vesicular, friable, fine sandy loam. |

Again I am amazed at the amount of gleization in such an apparently well-drained soil. But the material is so low in clay content that few cracks develop, and all the water must move through the very fine capillaries. This soil may be said to approach, perhaps, an imperfectly developed Planosol.



K-1736 February 19, 1949
New Zealand. Near Cust. Looking over stream
terraces to the downs.



K-1737 February 19, 1949
New Zealand. Northwest of Oxford. View on "yellow-
grey earth" tending toward "yellow-brown earth"
developed under New Zealand beech.

We join the main road again near Cust, and drive on west with a fairly well drained terrace to the south of us and a lower, imperfectly drained one to the north. The land is used mostly for fat lambs with some dairy cows. As we go west, the wetter terrace swings to the north. The material in these terraces resembles that of the profile just described, but with a still more prominent glei and with somewhat lighter-colored surface soils. Beyond Bennetts, some fields are in fallow and some in wheat stubble, besides hay and pasture. Within two miles, we come close to the strongly rolling foothills, the gentler slopes of which are used for cereals. Most of these slopes are in grass, except for a few patches of scrub.

We pass Oxford, on "yellow-brown earth." We go on pass Cooper's Creek and look at the soil on the strongly rolling to hilly grass-covered foot slopes. This soil is said to be a "yellow-grey earth" tending toward "yellow-brown earth" and developed under New Zealand beech. We look at the soil in a very dry road cut where there has been some disturbance. In the discussion, I can't help feeling that people here neglect the very surface horizons and depend a bit too much on road cuts and augers rather than proper pits in undisturbed places.

A ₁	0-6"	Pale brown (10YR 6/3), gritty silt loam. The soil is a mixture of granular and small subangular nut held together by grass roots. Fairly friable.
A ₂	6-9"	Pale yellow (2.5Y 8/4), with faint mottling with shades and a little gray, silt loam. Irregular poor medium nut. Friable with difficulty.
A ₃	9-15"	Yellow, mottled with slightly darker yellow, silty clay loam. Irregular, subangular medium nut.
B ₂	15-24"	Yellow, mottled with shades and brownish-yellow, silty clay loam. Imperfect medium nut. Fairly friable.
B ₃	24-32"	Very pale brown, mottled with reddish-yellow, gritty silt loam. Somewhat more friable than above.
C	32-48"+	Strong brown, very dark brown, and reddish-brown rotten graywacke. Coarsely fragmental. Roots penetrate into this material.

I suppose this could be a rather poor Gray-Brown Podzolic soil tending toward Planosol and Gray Hydromorphic. This soil seems to be obviously well drained, yet there is evidence of glei and poor internal drainage.

We drive south and stop at View Hill for a picnic lunch. The terraces appear to be well drained. The soil is used mainly for hay and pasture for sheep. There are quite a few pine planted as windbreaks. Many of the soils are cobbly in the surface and are now exceedingly dry.

We cross the Waimakariri River. This is a characteristic glacial stream that looks much like the Matanuska River in Alaska. The broad plain to the east has been built up from the cobbly and gravelly deposits of this stream as it wandered back and forth. The broad bed of the river has many bars of glacial silt. In the distance, we can see this blowing up out of the bed of the river over the land to the far southeast. These additions of fresh silt are said to have a striking effect on soil fertility.

South of the river to Sheffield and Springfield, the soils are less cobbly and the pastures are better. Besides sheep pasture, there are fields of potatoes, rape, and wheat. Some water is brought down from the hills in "stock races" but none is used for irrigation.

As we approach the mountains to the west, the steep peaks are seen to be nearly barren. It is said that they originally had much forest cover, removed through fire and overstocking.^{11*/} The foot slopes are well covered and have few slips. There is more erosion on the north-facing slopes, where the soils are more powdery and drier, than on the south-facing ones. As we go up into the mountains, the soils gradually change from "yellow-grey earth" to "yellow-brown



K-1775 February 19, 1949

New Zealand. Five miles south of View Hill. This is the Waimakariri River -- a typical glacial stream with loess blowing out of the beds in the distance.



K-1738 February 19, 1949
New Zealand. Two miles west of Springfield,
looking toward Mt. Torless.

earth." There is quite a bit of erosion, partly natural, partly accelerated. Besides, there is some soil blowing. The rocks are largely graywacke (shales and fine sandstones), badly contorted. Some beds are nearly vertical. At Porter's Pass (elevation 3,250 feet), we look at a Lithosol on a strong colluvial slope of 30 to 40 percent. The surface 6 or 7 inches are brown gravelly loam, with soft granular structure. This grades through fairly compact yellowish-brown gravelly loam to the broken country rock. There is a fairly good erosion pavement of small angular rocks of cobble and gravel size. The soil is covered with heavy, snow tussock grass, except for steep barren places. These barren places look like serious slips from a little distance. But when close at hand, one sees that the barren places are cobbly and have a well-developed erosion pavement. Besides tussock grass, there are many forbs, several mosses, and a few low shrubs.

These flattened, nearly barren areas, called "screes," are often growing. Mr. Taylor and the others think that a large part of this apparent erosion is accelerated as a result of overstocking. No doubt. But I am inclined to the view that a lot of this sort of thing has been going on under natural conditions. In fact, I am sure of it, because of



K-1739 February 19, 1949
New Zealand. West of Springfield near Porter's
Pass (El: 3250'). Tussock grass, mainly, with bare
gravelly spots (strong wind).



K-1740 February 19, 1949
New Zealand. West of Springfield near Porter's
Pass (El: 3250'). Tussock grass, mainly, with bare
gravelly spots. (Strong wind) (Broader view)



K-1741 February 19, 1949
New Zealand. West of Springfield near Porter's
Pass (El: 3250'). Tussock grass, mainly, with bare
gravelly spots. (Strong wind) (Another view)

the well-developed erosion pavements on sloping areas now well covered with vegetation. Without doubt, a lot more of the land is barren now than formerly. Yet, I can easily see that one looking at these mountains from a distance or from an airplane would get a wholly and completely incorrect notion of the processes going on. These bare places are entirely unlike the active slips in the North Island.

We go back to Sheffield and take the road through Darfield in the direction of Christchurch. We are again on smooth terraces with quite a bit of wheat and some peas. Beyond Darfield, the soils have gravelly and cobbly surfaces and there is some forest. The wind is strong today, and the land ahead has a haze of white dust, most of which probably originates from the silt bars in the Waimakariri River. We are soon on soil only a few inches deep over the cobbles. Yet the farms are quite good -- mostly with sheep and some cereals.

We stop 4 miles east of Darfield to look at this soil called "an intrazonal relative of yellow-grey earth." (The wind is terribly strong.)

A₁

0-3"

Gray loam; hard in place; slightly platy, with flattened roots beneath the plates. Friable under medium pressure.

A ₂	3-10"	Pale yellow to nearly white sandy loam. Somewhat platy, quite brittle and easily friable to powdery fine granular.
B ₂	10-18"	Pale yellow loamy gravel.
B ₃	18-30"	Grayish-brown loamy gravel and cobbles.
C		Comparatively loose, light-colored Pleistocene gravels and cobbles.

The land is nearly flat, and much of the Canterbury Plain is said to have soil like this. On part of it there has been less covering of wind-blown silt, and the gravels are nearer the surface.

I explain to Mr. Taylor that in the United States we should include such a soil with the zonal group and regard it as transitional to the azonal rather than the intrazonal. He agrees.

We go on east and pass into an area receiving dust from this same Waimakariri River. Here there are many small low dunes of fine sand oriented from northwest to southeast. Even so, some areas between the dunes have cobbly surfaces. The dunes fade out after about 8 miles even though significant amounts of dust are being deposited as well as removed from cultivated fields.

About $2\frac{1}{2}$ miles west of Yaldhurst, we pass through a shallow, cobbly strip -- an old river bed. Then we come

A₂ 3-10" Pale yellow to nearly white sandy loam. Somewhat platy, quite brittle and easily friable to powdery fine granular.

B₂ 10-18" Pale yellow loamy gravel.
B₃ 18-30" Grayish-brown loamy gravel and cobbles.

C Comparatively loose, light-colored Pleistocene gravels and cobbles.

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About 2½ miles west of Yaldhurst, we pass through a shallow, cobbly strip -- an old river bed. Then we come



K-1742 February 19, 1949
New Zealand. Four miles east of Darfield. Cut showing stratified gravel from glacial streams covered with a thin layer of wind-blown silt and very fine sand. An associate of the "yellow-grey earth."

onto a fairly deep sandy loam terrace, nearly level, that runs east to Christchurch. Here are some nice farms. There is wheat, rape, and some land in fallow, but mostly hay and pasture for sheep and dairy cattle. There are many low, shrubby hedges in rows and clumps of pine or other trees.

On the way into Christchurch, I see a lot of very nice flower gardens laid out in the English manner.

In the evening Dr. Grange and Mr. N. H. Taylor come over to my hotel, and we go over the notes for a wireless talk and discuss the UNESCO-FAO manuscript.

lack of frost, some market gardening is being done on very steep slopes where the erosion hazard is serious.

One-half mile east of Dunedin, we look at the Dunedin silt loam. The land is strongly rolling to hilly. We are about 800 feet above sea level. The depth to rock is amazingly variable. There are a few rock outcrops. This hilly area was undoubtedly an island in the sea when the Canterbury Plains was submerged. The slope is about 15 to 25 percent where we look at the soil. The vegetation is tussock grass, brown shrub, sweet vernal, and *Leptocarpus* grasses. What else is used, white clover, ryegrass, and the like, some is for good pastures.

February 20

At 9:10 a.m. I leave the hotel for a field trip southeast of Christchurch with I. L. Baumgart, C. S. Harris, and C. G. Vucetich, (I. J. Pohlen). We drive through the Cashmere Hills east of the city. These are basalt with a veneer of fine material blown out of the Canterbury Plain. Although there are frosts in Christchurch, it is said that there are none on these hills. Here the rainfall is about 25 inches. It goes up to 45 inches, and higher, near the sea. Because of the favorable moisture and lack of frost, some market gardening is being done on very steep slopes where the erosion hazard is serious.

One-half mile east of Takahe, we look at the Cashmere silt loam. The land is strongly rolling to hilly. We are about 800 feet above sea level. The depth to rock is exceedingly variable. There are a few rock outcrops. This hilly area was undoubtedly an island in the sea when the Canterbury Plain was submerged. The slope is about 15 to 20 percent where we look at the soil. The vegetation is tussock grass, broom shrub, sweet vernal, and Danthonia grasses. When lime is used, white clover, rye grass, and the like, come in for good pastures.

A₁₀ 0-3" Dark gray silt loam. Fine and medium soft granular structure held together by grass roots.

A₁₁ 3-6"
(5-8") Dark grayish-brown (10YR 4/2) silt loam. Very poor nut and granular; easily friable to granular; more compact than above.

Grades into:

A₂ 6-12" Very pale brown (10YR 7/3) very fine sandy loam to silt loam. Irregular breakage; suggestion of poor blocky. Now dry, friable under very hard pressure to powdery fine granular.

A₃ 12-20" Very pale brown, mottled with reddish-yellow, highly vesicular silt loam. Some cracking, but generally massive. Small clods friable under very heavy pressure to powdery fine granular. Somewhat compact in lower part.

B₂ 20-30"
(28-36") Brown (10YR 5/3), mottled with pale brown and light gray, very compact, hard silt loam. There are a few large cracks. The walls are uniformly brown except for fine, matted grass roots. The soil is very hard to dig out. Small pieces are brittle and friable under extremely hard pressure. Slightly vesicular.

C 30-72"
(about) Pale yellow, softly mottled with shades and pale brown, silty, very fine sandy loam. Compact, but less so than above. Digs out in large subangular chunks that are friable under pressure. Slightly vesicular.

D Gray and brown basalt.

In the New Zealand Soil Survey, this is called a "moderately leached, tussock-melanized, yellow-grey earth." According to results of samples collected here, the base saturation is said to be 50 percent in the upper part and 75 percent in the C. Again I am amazed at the evidence of glei, but here I am confident that there has been solonization and solodization, perhaps when the area was surrounded by the sea. A lot of salt must have been added.

We drive on east and south. There is dairying and fruit growing in small holdings. I see some alfalfa and many hedges and small clumps of trees. The houses are small. This road looks a lot like England.

We go along on the plain. At first there are some cereals, but soon we see mostly sheep pastures. As we near the sea, we pass over low, wet, salty, young soils from marine sediments. These give poor sheep pastures. Just beyond Kaituna near Lake Ellesmere, I look at an imperfectly drained terrace. The surface 15 inches are a dark grayish-brown, fine sandy loam; underneath, compact gray and light gray very fine sandy loam, mottled with reddish-yellow. Although compact in place, the soil is easily friable when removed. At about 24 inches, the material loses its compactness, and at 30 inches or so, grades into brown, water-soaked, very fine

sandy loam. There is little evidence of salinization or
solonchaks here. The pasture is good except during very
dry periods.

Beyond Little River, the better forest begins, with
40 inches of rainfall. The land is strongly rolling to
hilly. The upper slopes are from basalt, while the lower
slopes

These

of are

trees.

but no

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on the

Above

On the



K-1743 February 20, 1949
New Zealand. East of Kaituna. Windmill in sheep
pasture.

Relatively, for this general section, the pastures are good
in summer because of the better rainfall as compared with the
plains near Christchurch. Whereas the pastures in the
Canterbury Plain are brown, these are now green.

sandy loam. There is little evidence of salinization or solonization here. The pasture is good except during very dry periods.

Beyond Little River, the totara forest begins, with 40 inches of rainfall. The land is strongly rolling to hilly. The upper slopes are from basalt, while the "easy" slopes have a covering of coarse, silty, wind-blown material. These soils have good pastures for the most part, largely of orchard grass (cocksfoot). There are some clumps of trees. There are quite a few slips; most of these are healed, but not all of them. On many slopes are some large slides. In places, the land is very stony. Below about 1,000 feet on the "easy" slopes there are dairy cattle and fat lambs. Above 1,000 feet, there are mostly beef cattle and sheep. On the lower slopes, 1 cow requires about $2\frac{1}{2}$ acres.

Some orchard grass (cocksfoot) paddocks are fenced off, cut for seed, and then sheep are turned in during the winter to eat the standing roughage.

Some very steep land in this area is used for dairy cows. Relatively, for this general section, the pastures are good in summer because of the better rainfall as compared with the plains near Christchurch. Whereas the pastures in the Canterbury Plain are brown, these are now green.



K-1744 February 20, 1949
New Zealand. Across the bay from Akaroa. Note
that trees have been properly left in the critical
places and prevent slips.

We go on up to the divide at 1,530 feet, and get a gorgeous view of Akaroa Harbor. Here the trees have been left properly along the gullies and in the steep places for erosion control. This area is exceedingly complex, with variations in depth of the wind-blown silt (loess?) over the rock. The wind-blown material varies widely in texture. In the road cuts one sees banding from temporary weathering zones or from differences in the added material.

About $1\frac{1}{2}$ miles east of Duvauchelle, we look at the Pawson silt loam, a "moderately gammate, moderately weathered, moderately leached, yellow-brown earth." The land is strongly rolling. The soil is developed from wind-blown material lying over basalt. Originally the cover was totara forest, but now it is mainly pasture grass with trees confined to the coves and gully sides.

A ₁₀	0-3"	Light brownish-gray (10YR 6/2), loose, granular, silt loam, held by grass roots.
A ₁₁	3-7"	Like the above, but slightly more compact.
A ₂	7-12"	Very pale brown (10YR 7/3 to 7/4), heavy very fine sandy loam. Imperfect irregular small to medium nut, easily friable to granular.

- A₃ 12-23" Very pale brown, faintly mottled with shades and with some specks of reddish-yellow, silt loam. Massive, with some tendency toward irregular coarse blocky. Fairly easily friable. Vesicular. Mottling increases with depth.
- B 23-42"
(36-48") Pale brown, strongly streaked and mottled with reddish-yellow, heavy silt loam to very fine sandy clay loam. Massive, with some cracking. Digs out in coarse irregular blocks that are friable under hard pressure. A bit harder in the lower part. Fairly vesicular. Matted and flattened roots along the cracks.
- C 42-60"+ Pale brown, mottled faintly with shades, vesicular, massive, heavy silt loam. Some irregular cracks. Gray soil with reddish-yellow mottling follows deeply in the cracks. Fairly friable under pressure.

The face of the cut shows a geometric pattern of cracks with gray soil lining them. These cracks are about 3 to 18 inches apart. Water and roots go down into these cracks. They are filled with a gray soil mottled and streaked with reddish-yellow in bands $\frac{1}{2}$ to 1 inch wide. Obviously there are alternately reducing and oxidizing conditions. In road cuts the blocks become rounded and can be very easily pried out as large chunks with relatively smooth surfaces.

Slips are likely to be very bad on this soil where critical slopes do not have trees. Water enters the cracks

rapidly. These are covered by
soon becomes saturated.

It begins to rain and we go on
while it clears. After lunch, we go
the southeast. Six miles from Duvauchelle



K-1745 February 20, 1949

New Zealand. One and one-half miles east of Duvauchelle. Undressed road cut in Pawson silt loam -- a "yellow-brown earth, moderately weathered, moderately leached, and moderately gammate." This shows clearly the peculiar structure of the lower solum, with glei in the cracks, associated with "gammate."

rapidly. These are narrow in the C and the lower solum soon becomes saturated.

It begins to rain and we go to Duvauchelle for lunch while it clears. After lunch, we go higher in the hills to the southeast. Six miles from Duvauchelle we stop on a saddle between Okains Bay and Duvauchelle Bay. The soil here is Sumit silt loam -- a "skeletal yellow-brown earth." I should call this a Brown Forest soil with very slight podzolization. The land is strongly rolling to hilly and the slope here is 30 percent or more. Originally the cover was broad-leaf forest, but now it is pasture grass.

- | | | |
|----------------|---------|---|
| A ₁ | 0-9" | Dark yellowish-brown (10YR 4/4) heavy very fine sandy loam to silt loam. Loose subangular medium nut and granular held together by grass roots. Easily friable. The upper one inch is matted a bit. Fades in lower part and grades into: |
| B | 9-30" | Yellowish-brown (10YR 5/4) silt loam. Very slightly compact. Massive to irregular medium nut. Quite easily friable. Vesicular. Gross irregular cracking. Some small, circular, filled root channels. |
| C | 30-60"+ | Light olive brown (2.5Y 5/4), mottled softly and faintly with yellowish-brown and gray, silty very fine sandy loam. Slightly compact. Easily friable when removed. Irregular cracks, with matted roots along them, for 6 feet or more. Vesicular. The soil digs out in large, angular, irregular blocks 12 to 24 inches across. Very little color change at the cracks. |

rapidly. These are narrow in the C and the lower column

soon becomes saturated.

It begins to rain and we go to Duvanchelle for lunch

while it clears. After lunch, we go higher in the hills to

the southeast. Six miles from Duvanchelle we stop on a

saddle between Okains Bay and Duvanchelle Bay. The soil

here is "Semit alf loam" -- a "skeletal yellow-brown earth."

I should call this a Brown Forest soil with very slight

podsolization. The land is strongly rolling to hilly and

the slope here is 30 percent or more. Originally the cover

was broad-leaf forest, but now it is pasture grass.

Dark yellowish-brown (10YR 4/4) heavy very fine sandy loam to silt loam. Loose subangular medium and granular held together by grass roots. Easily friable. The upper one inch is mottled a bit. Fades in lower part and grades into:

0-9"

A₁

Yellowish-brown (10YR 5/4) silt loam. Very slightly compact. Non-ive to irregular medium nut. Quite easily friable. Vesicular. Gross irregular cracking. Some small, circular, filled root channels.

9-30"

B

Light olive brown (2.5Y 5/4) mottled coarsely and finely with yellowish-brown and grey, silty very fine sandy loam. Slightly compact. Easily friable when removed. Irregular cracks with mottled roots along them, for 6 feet or more. Vesicular. The soil digs out in large, angular, irregular blocks 12 to 24 inches across. Very little color change at the cracks.

30-60"

C

D (Variable) 1949

The pastures have been used for

years. I see some nice Hereford cattle

on into the uplands. In many places



K-1746 February 20, 1949

New Zealand. Six miles from Duvauchelle on saddle
above Okains Bay. View on Summit silt loam --

"skeletal yellow-brown earth." Note the remains of
the ring-barked trees and Hereford cattle.

D (Variable) Basalt.

The pastures here have many remains of the ring-barked trees. I see some nice Hereford cattle in them. We continue on into the uplands. In many places I see that the basaltic fragments are mixed with the wind-blown material through the action of slips.

We swing northwest and return to Little River. In road cuts I see some brown soils from basaltic ash over the basalt. The basalt seems not to have weathered much. We join the road near Hill Top and return to my hotel in Christchurch a little after 4:00.

I finish my wireless speech for tomorrow and go to dinner. After dinner, I attend a brief meeting of the Americans attending the Conference. This meeting deals chiefly with travel arrangements for people whose passage had been cared for by the Military Air Transport Service. Several came to the meetings in this way, apparently without charge, and will return the same way March 4. There are introductions and a little discussion about program changes for the next meeting.

February 21

A few minutes before 9:00 a.m. a very nice car calls and takes me to the broadcasting station where I give the following address, summarizing the discussions of the Pacific Science Congress on soils and agriculture.

The Seventh Pacific Science Congress

Soil Resources

I shall try to say a little about the program on soil science at this Seventh Pacific Science Congress. We disagreed on some points, and, of course, these were the ones we discussed in most detail. But soil science has come a long, long way in recent years. The efficiency of soil use is increasing every day. Yet not everywhere.

Here in New Zealand, farmers have done well. I have seen many of the farms and I have seen some of the scientific work back of that progress -- the work in plant breeding for good strains of grasses and clovers, the improvements in livestock, the growing use of proved dairy sires, methods for the control of weeds, and so on. Then there is the spectacular story of cobalt and how that one scientific discovery alone has resulted in increased efficiency on thousands of farms and will make possible the establishment of thousands

of good new farms. This discovery of the cause and cure for "bush sickness" resulted from careful work by New Zealand scientists, who took full advantage of the discoveries of scientific workers in other countries in chemistry, plant nutrition, geology, and soil science. It demonstrates dramatically the value of international science. Then too, painstaking soil surveys have been necessary to guide the corrective measures -- and the use of the special fertilizers. It is fortunate that the soil survey of New Zealand is so far advanced, otherwise the many new fertilizers and other improvements should need to wait a long time for application to the farms.

Of course, farmers in New Zealand know more about those accomplishments than an overseas visitor, at least those farmers who have taken advantage of them and who have increased their production while improving their soils at the same time.

Unfortunately, not all farmers in New Zealand -- just as in my own country -- have seized these opportunities. Production could be increased a great deal more in New Zealand if all farmers did what a substantial percentage have found it to their advantage to do. And only a beginning has been made in the application of science to farming. I'm confident that given peace and good-will, we shall see even greater

improvements in the next 20 years than we have seen in the past 20 -- far greater. For example, New Zealand has hardly more than begun to make full use of the available water for supplemental irrigation. Overgrazed areas need to be brought under control before erosion becomes really serious. The erosion in the high hilly land should be stopped now with fire control and balanced grazing before streams are clogged and good soil in the lowlands is injured. Then, many slopes in the more humid sections need forest plantings. Both scientists and farmers in New Zealand have a lot to do to realize the full potentialities of this great land. It will mean work. Nothing can be taken for granted -- not for long.

Above all, at this Congress one senses the urgency of the world food problem, and a large part of that problem is in the Pacific Area. No one can rest easy, while others face the threat of starvation. Yet many do face that threat today.

I think it is fair to say that most soil scientists feel that this problem could be met as far as soil is concerned. That is, we have the acres and we have methods for managing them safely for adequate production, if science could only be put to work. We know there are many unused acres in the

tropics that could be farmed, but we lack soil maps to show where they are and their potentialities.

To achieve full production, four important goals must be sought at the same time. These are: first, production -- efficient production for the farm family and the community; second, conservation of soil and water for efficient use; third, good living standards for rural people -- standards of health and education; and fourth, full use of the labor and genius of rural people -- so they may work efficiently with enough tools and enough acres. Neglect of any one of these four goals, or even overemphasis of any one at the expense of the others, will prevent progress.

Further, scientific agriculture depends upon scientific industry within the same country or at least in the same customs union. Farmers need chemical fertilizers, insecticides, fencing, machinery, and other industrial products. In many areas, a part of the population needs to be employed in industry to produce these things, leaving the others with soil enough for efficient management.

Just as one example: Fertilizers are now in very short supply. Farmers need more. We also need more concentrated fertilizers so the big costs for transport can be reduced. Here is an industrial problem of vital interest to farmers,

and a solution is essential for abundant production, especially in the tropical areas.

Another example is electric power. The extension of meat and milk production in warm countries depends upon electric power. We have a good lesson in New Zealand. Perhaps some of you now almost take for granted the great effects of electric power on your agricultural efficiency. Here again, only a beginning has been made.

We may say then that most scientists agree that the physical and biological problem involved in adequate food production are solvable. But this is not saying that the political and social ones are.

Scientific research and a rapid extension of soil classification and mapping throughout the Pacific Area are urgent requirements. But more is needed also. Educational or advisory programs adapted to the various kinds of people are essential, and so are tenure and credit and market institutions adapted to their circumstances.

The Conference also took special notice of the hazard of soil erosion that follows clean cultivation of sloping, erosive soil, overgrazing, or bush fires or clean cutting of forests on steeply sloping land. None of these are necessary. All are within man's control, and their control gives increased production

if viewed over a brief span of years. The control of erosion is intimately related to the farm management system, the kind of crops used, the application of fertilizer, and so on.

Certainly the greatest problem is the one of getting farm families to take the long view of their land -- their production over 10 or 15 years, not just next year. Many of the most productive farm management systems take time to install.

Certainly the exchange of views and experience among soil scientists from the several countries will help all of us to do a better job. There is no one answer, no one approach to more efficient soil use. Just as there are many kinds of soil, climate, crops, and people, there are many good methods of farm management. In fact, we must beware of the simple answer. It doesn't exist. This should not discourage us; rather, complexity makes the world interesting and stimulating.

Science helps us sort out these complexities and see how various kinds of soil and farming methods are related.

That is why the Conference laid so much stress upon soil classification and soil mapping, and their interpretation.

Through such exchanges of ideas as this Congress in New Zealand has made possible, soil scientists from the various countries make progress toward a common nomenclature. They can use the knowledge and experience of those in other countries where it applies in their own.

Thousands of soil types exist, each with its own potentialities for use. Practices good on one may be ruinous on another. Yet we cannot experiment on every farm. Nor do we need to. Once the kind of soil to be dealt with is known, then all the scientific knowledge and experience gained by farmers on that soil is available for application.

This is recognized by the Congress as the only sound way, the only economical way, to proceed rapidly. The classification and mapping of the soils in the Pacific Area need to be pushed forward as rapidly as trained workers can be had. Then other research and advisory programs for sustained production for both conservation and production can go forward. Without soil maps, waste and failures are almost certain.

Of course, scientists cannot do this alone. They must have public support, which can only come from public understanding. Perhaps most basic of all is the appreciation of the interdependence among people and countries. If people want peace and abundance badly enough, they can have it.

I repeat: we cannot solve the problem of food for the world with one, or even a few, bold strokes. In such matters we go from one stage to another, without seeing all of the final pattern. The important thing is to keep moving in the right general direction.

For New Zealand, it means making more of the great potentialities here. And it means lending a hand to help others get their scientific work underway -- to help them with soil classification and soil mapping, and with the other research work, and to help them get advisory services going. And to do all this while there is still time. We shouldn't waste the peace we have.

- - - - -

After the talk, they ask me for my manuscript. Heaven help the poor typist!

Then I go to the Agricultural Section for the program on pastures. These papers are descriptive and not very interesting. Later there is a program on minor nutrients. Laird summarizes Palmer's paper, he says, briefly (!). It would have gone much faster if he had read the whole paper.

As with many similar conferences, one is impressed with the relatively few useful papers. On the one hand, many papers are too general -- too platitudinous. On the other,

many are filled with details of the minor geographic features of distant lands, minor differences in figures, and so on, that cannot be grasped in rapid speaking. It works out best of all where the papers are mimeographed in advance and presented by summary, with the discussion concentrated for each group of papers on a single topic.

After lunch, some of us go to look at the soil exhibits. These include a large soil map of the North Island on a scale of 4 miles equals 1 inch. One hundred and thirty-two soil types are shown plus many phases. A lime map has been prepared by interpretation. It is as follows:

- I. Little or no response to lime.
 - A. Sufficient lime in soil.
 - B. Low lime in soil, but soil fails to respond.
- II. Slight to moderate response to lime.
 - A. Lime slightly deficient in soil.
 - B. Lime deficient in soil, but only slight or moderate response.
- III. Good response -- lime deficient in soil.
- IV. Strong response -- lime very deficient in soil.
- V. Steep land, generally above 20 to 30 degrees of slope, not considered feasible for liming.

Another interpretative map groups the soils into 6 general classes with several subdivisions according to fertilizer

response, drainage, and the like. This one is called
Potential land use for pastoral purposes.

Class I

Flat and rolling land (plowable) that is or can be converted into high-quality land.

- A. Without fertilizers.
- B. With fertilizers.
- C. With drainage.
- D. With drainage and fertilizers.

Class II

Flat and rolling land that is or can be converted with fertilizers into fair- or medium-quality land.

- A. Limiting factor -- summer moisture.
- B. Limiting factor -- texture, structure, or elevation.

Class III

Flat and rolling land that has several limitations to productivity and needs further investigation before development.

- A. Very infertile "brown loams" with high phosphate fixation and low moisture.
- B. Low fertility on soils wet in winter and dry in summer.
- C. Flat soils, low fertility, shrinkage, and difficult moisture conditions.
- D. Plateau soils of fairly high elevations, mainly above 2,000 (?) feet, that are cold or wet in winter.

E. Very dry sandy, gravelly, or stony soils.

F. Saline soils.

G. Wet soils -- not peaty.

Class IV

Hilly or steep land that will maintain pasture without top dressing.

A. With no erosion.

B. With slight or moderate erosion.

Class V

Hilly or steep land that will maintain pastures (with clover), if top dressed and carefully managed.

A. Top dressing includes basic phosphates, with little or no erosion.

B. With little or no erosion.

C. With slight or moderate erosion.

Class VI

Hilly or steep land that has severe limitations.

A. Low fertility -- deficient in lime or phosphate.

B. Low fertility under high rainfall with reversion to second growth.

C. Is eroded, or is liable to be severely eroded.

D. Gravelly soils that dry out.

Obviously, this legend needs some reworking, which we discuss with Dr. Grange.

K. Very dry sandy, gravelly, or stony soils.

L. Saline soils.

M. Wet soils -- not peaty.

Class IV

Hilly or steep land that will maintain pasture without top dressing.

A. With no erosion.

B. With slight or moderate erosion.

Class V

Hilly or steep land that will maintain pasture (with clover), if top dressed and carefully managed.

A. Top dressing includes basic phosphates, with little or no erosion.

B. With little or no erosion.

C. With slight or moderate erosion.

Class VI

Hilly or steep land that has severe limitations.

A. Low fertility -- deficient in lime or phosphate.

B. Low fertility under high rainfall with overabundance to second growth.

C. Is eroded, or is liable to be severely eroded.

D. Gravelly soils that dry out.

Obviously, this legend needs some reworking, which we

discuss with Dr. Grange.

They have several monoliths, two of which I try to photograph. These Norman Taylor explains briefly. I urge him to write papers for Soil Science on Kauri Podzol and on soils with the gammate structure. So far as I can see, few, if any, of the principal groups as recognized in New Zealand fit neatly, if at all, with the great soil groups as defined in the world literature, except for a few of the intrazonals. They have done well here to use their own names and postpone attempts to correlate their soils with the other world groups until the modal definitions have been established.

After dinner, Taylor and I have some chit-chat, and I go to bed early. research. He says that it is specified, however, that they shall not engage in fundamental research. Yet he says that a soil survey of Fiji is to receive special emphasis! (I fear for the results.) They hope to find what are the best cropping systems, how to improve their livestock, and how to develop their market gardening. The coconut plantations are especially critical. I was impressed that they intend to use unit-test farms in order to test the economic feasibility of the new systems. In conclusion, he points out that fundamental research is essential to any real progress in research on immediate, practical problems, to which the Department of Agriculture is limited.

February 22

I get up in a cool, gray morning for the last day of the conference. I go to the Agriculture Section.

J. Claridge explains the New Zealand scheme of seed certification. We are shown a good propaganda film on the menace of rabbits in New Zealand and methods for their eradication.

At morning tea, I speak for a few moments with Mr. Cotton, the well-known New Zealand geomorphologist.

Mr. Blackey of Fiji explains the organization of the Department of Agriculture. It is not entirely clear to me. He says that there are two functions: (1) education and advisory, and (2) research. He says that it is specified, however, that they shall not engage in fundamental research. Yet he says that a soil survey of Fiji is to receive special emphasis! (I fear for the results.) They hope to find what are the best cropping systems, how to improve their livestock, and how to develop their market gardening. The cocoanut plantations are especially critical. I was impressed that they intend to use unit-test farms in order to test the economic feasibility of the new systems. In conclusion, he points out that fundamental research is essential to any real progress in research on immediate, practical problems, to which the Department of Agriculture is limited.

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W. E. van Steenburgh of Canada presents a very dry review of detailed administrative devices that have no relationship to the title of his paper, The influence of scientific trends on agricultural research in Canada.

Mr. L. W. Tiller discusses the advantages of having industry associations cooperate financially in research. He says that in this way industry pays more attention to the results, since they carry 50 percent of the cost, and the staff knows more about their problems. They already have such industry associations in dairying, for wheat, tobacco, and hops. The disadvantages are not discussed. It seems to me that there are some.

At noon I check with the bank of New Zealand and get all my papers in order for leaving. The New Zealand Broadcasting Company sends me a check for 5/5/0, which I turn over to Dr. Grange to be used for something in the Soil Bureau.

After lunch I go to the last plenary session of the Congress. Research plans and recommendations have all been well cut and dried. The passing of these recommendations and resolutions is followed by the usual pretty speeches. The whole is a bit boring.

Professor Robinson and I say goodbye to our friends in the Soil Bureau who leave on the boat this evening for

Wellington. We regret leaving Norman Taylor, Hamilton, and Grange, whom I feel I have come to know and respect very much, even though our acquaintance has been so short.

Just after dinner, J. K. Taylor and I discuss the work of the proposed standing committee on soil and land classification for production and conservation. It is proposed that his group prepare a detailed bibliography for the South Pacific and that we do so for the North Pacific. Ideally, we should have three maps with accompanying interpretations: (1) a soil map, (2) land classification according to potentialities for use in as many breakdowns as practicable for the data at hand, and (3) present intensity of use. By comparing maps 2 and 3, the unexploited land can be seen.

We walk over to the final conversazione and I tell him goodbye. I stay for a while and say goodbye to many of the people I have been with during the Congress. Several New Zealand people tell me how glad they are I came, and they do it very charmingly, even convincingly. It is especially difficult to say goodbye to Professor Robinson and to Director Kay. Both of these men are English gentlemen at their very best, which is very good indeed.

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February 23

This is a cool, cloudy, rainy morning, but not bad enough to ground my plane for Auckland. Most of the packing is done before breakfast. I have a few final conferences and complete my "papers."

A little before noon I go to the air station and from thence to the airport. Just as we are scheduled to leave, some fellows come late, fellows who apparently have influence and delay everything while they weigh in leisurely. At 12:48 we leave for Auckland.

We fly north over the Canterbury Plain, most of which is laid out geometrically and irregularly in small fields. One can pick out the soils deepest over the gravel. These are used for hay and pasture and are now green. The fields with cereal stubble and brown pasture are on the more gravelly types.

Soon we go east and fly north over the sea. Old dissected hills along the coast near Waipara are now brown, although they seem well covered. North of Port Robinson the hills seem to have less cover, although we are now far out to sea. Clouds in the northwest are creeping down almost to the eastern coast. When we approach Wellington, we are flying into soupy clouds and it gets cold in the plane. What a pity that we fly

for hours over beautiful mountains and cannot see a thing -- can only hope that we do not run into one of them.

The clouds break a bit just before we land at Whenuapai airfield at 4:55 p.m. It is a long, tedious ride by bus and taxi to the hotel in Auckland. I go to bed early, since I won't have another rest for a long time. It is a real job straightening my back this night.

At 10:13 a.m. we are in the air for Fiji. Right away we are served the old familiar Poros for our landing in Fiji: where did you sleep last night, the night before, and so on for 24 nights. Considerately, no further particulars about the accommodations are required.

As the day wears on, we lose a bit more time. We are due in Fiji at 4:00 p.m. We land at 5:00 with a bump.

Dinner is served, but I eat very little. Mr. Young, a fellow traveller, and I hire a taxi and take a small trip a few miles from the airport for half an hour or so. We see sugarcane that resembles what in northern Queensland, rice, both upland and paddy, wheat, bananas, coconuts, and some hay crops. We pass thatched, rectangular Fiji houses in villages and also the slightly more substantial Indian houses. Only very small boys are without clothing.

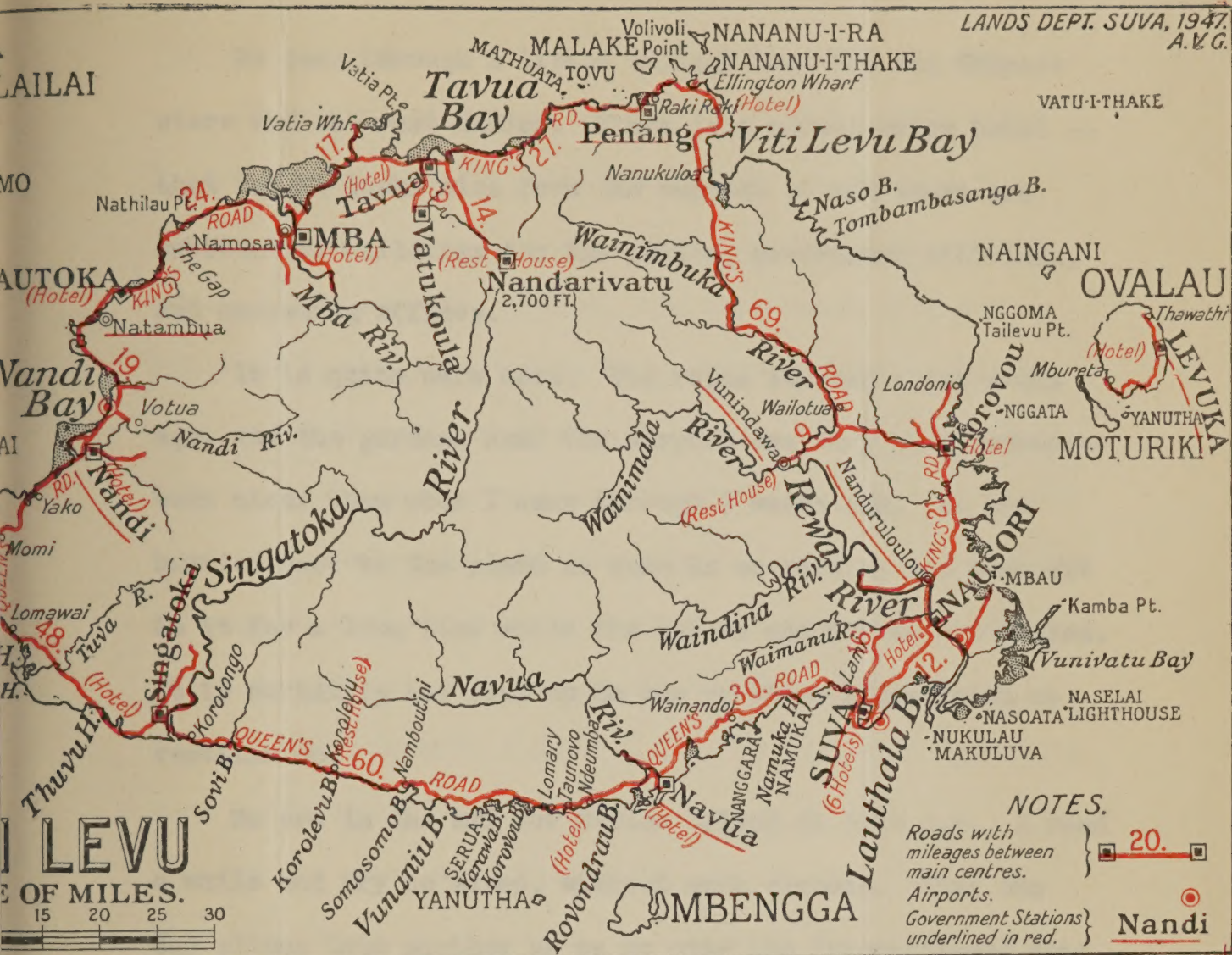
February 24 (a)

I am up early and hope everything is in order for the trip home. The hotel makes an extra-special concession and gives me breakfast at 7:15. The airport bus picks me up at 7:30. The day is warm and humid, and the sky has thin clouds. We arrive at the airfield at 8:30, after another tedious ride. I planned my baggage well; I weigh in at exactly 66 lbs.

At 10:13 a.m. we are in the air for Fiji. Right away we are served the old familiar forms for our landing in Fiji: where did you sleep last night, the night before, and so on for 14 nights. Considerately, no further particulars about the accommodations are required.

As the day wears on, we lose a bit more time. We are due in Fiji at 4:00 p.m. We land at 5:07 with a bump.

Dinner is served, but I eat very little. Mr. Young, a fellow traveller, and I hire a taxi and take a small trip a few miles from the airport for half an hour or so. We see sugarcane that resembles that in northern Queensland, rice, both upland and paddy, wheat, bananas, cocoanuts, and some hay crops. We pass thatched, rectangular Fiji houses in villages and also the slightly more substantial Indian houses. Only very small boys are without clothing.



We pass through a little village that has one Chinese store and the rest Indian. There is a nice-looking hotel -- that is, it looks nice from the outside -- and there are substantial buildings for the police, government officials, and marketing offices.

It is quite warm here. The rains started a few weeks ago, and the gardens near the airport are very nice indeed -- even nicer than when I came through 7 weeks ago. We are hurried back to the plane as soon as we return, and then sit in it for a long time while the motors and brakes are tested. It is certainly hot shut up in one of these planes with no ventilation.

We are in the air for Canton Island at 6:20 p.m. I read a while and try to sleep, without much success. Thus one day slides into another as we go over the international date line and start a new February 24.

Mr. Aichter has taken a long lease on a beautifully designed and furnished house directly on Makiki Beach. It is a pity that I am so tired after this long plane flight from Auckland that I have to go to bed by 10:30.

February 24 (b)

The steward wakes me up about 12:05 a.m., just after I have been asleep for a half hour, for the landing at Canton Island. I don't know why we are warned so much in advance. We are down at 1:25. We have sandwiches and fruit while the plane is serviced and are then in the air again at 2:30 a.m. for Honolulu. What a tiresome morning! Made worse by an hour's delay into Honolulu due to a steady headwind. We are down in Honolulu at 2:00 p.m. Dr. Auchter is here to meet me and I go through the customs in a hurry. Dr. Bruce Lyon is with him and on the way uptown we go through the pineapple cannery. I go to the Moana Hotel and have a little rest before dinner.

In the evening, I have dinner at the Auchters' home with Dr. Baver, Dr. Sherman, Dr. Gortner, Mr. Thorne, and others and their wives. The evening is very pleasant. Dr. Auchter has taken a long lease on a beautifully designed and furnished home directly on Waikiki Beach. It is a pity that I am so tired after this long plane flight from Auckland that I have to go to bed by 10:30.

February 24 (p)

The steward wakes me up about 12:05 a.m., just after I have been asleep for a half hour, for the landing at Canton Island. I don't know why we are warped so much in advance. We are down at 1:25. We have sandwiches and fruit while the plane is serviced and are then in the air again at 2:30 a.m. for Honolulu. What a tiresome morning! Made worse by an hour's delay into Honolulu due to a steady headwind. We are down in Honolulu at 2:00 p.m. Dr. Auker is here to meet me and I go through the customs in a hurry. Dr. Bruce Lyon is with him and on the way uptown we go through the pineapple cannery. I go to the Moana Hotel and have a little rest before dinner. In the evening, I have dinner at the Anchorage home with Dr. Bayer, Dr. Sherman, Dr. Gortner, Mr. Thorne, and others and their wives. The evening is very pleasant. Dr. Auker has taken a long lease on a beautifully designed and furnished home directly on Waikiki Beach. It is a pity that I am so tired after this long plane flight from Auckland that I have to go to bed by 10:30.



Upon arrival in Honolulu from any point outside the United States, passengers, baggage and cargo remain in quarantine until proper clearance has been effected by U.S. Government agencies. This is normally a lengthy process, depending upon the number of passengers aboard your plane as well as other planes being entered at the same time; but every effort is made to avoid tiresome waits by expediting your entry formalities.

PUBLIC HEALTH AND IMMIGRATION INSPECTION

Immediately upon arrival, a U.S. Public Health Officer will board the Clipper to make a brief inspection, during which time passengers are requested to remain seated. As soon as this inspection is completed, all passengers will disembark and proceed to the restricted clearance area. When leaving the plane, please take with you all personal belongings which you have with you in the cabin, and have ready for inspection your passport and other travel documents, including smallpox vaccination certificates and the International Certificates of Origin and Health which you have completed prior to landing.

U.S. CUSTOMS BAGGAGE INSPECTION

Upon completion of Health and Immigration inspection, you may proceed to the Customs area to identify your baggage and to present to the Customs Inspector the Baggage Declaration which you filled out prior to landing. All baggage is inspected at Honolulu, the port of entry into the United States.

CONTINUING AND CONNECTING FLIGHTS

If you hold onward space confirmed on the same plane, your baggage will be re-loaded and you are requested to check in at the PAA counter in the Terminal Building no later than thirty minutes prior to scheduled departure time. Planes are not held for late passengers.

If you hold continuing reservations on a later Clipper or if you desire to arrange onward or return travel, please consult the PAA representative on duty in the arrival clearance area.

TRANSPORTATION TO HONOLULU

Limousine service is available to downtown Honolulu (approximately 4 miles) at a charge of \$1.00, and to Waikiki district (approximately 7 miles) at a charge of \$1.50. Limousines leave the airport 15 minutes after the Clipper's arrival.

AIRPORT FACILITIES

Telegrams and cablegrams may be sent via commercial cable. Telephone booths are available to passengers in the Terminal lobby. There is a coffee shop, and a barber shop where shower baths are available for a nominal fee. At the PAA ticket counter in the Terminal there is a complete message file containing confirmations of requested transportation, messages from friends or relatives. If you are expecting a message, please inquire.

SIGHTSEEING

Our representative at the PAA Counter will help you arrange for a car for a short sightseeing tour if your schedule permits sufficient time. These cars are provided by independent concerns whose rates are reasonable - but you are again cautioned to be back at the airport no later than 30 minutes before your scheduled departure time. Your plane cannot be held if you are late.

HOTELS

If you are stopping or staying over in Honolulu and desire assistance in arranging hotel accommodations, our representative at the PAA Counter will gladly help you.

DEPARTURE FROM HONOLULU

If you depart at a later date for the U.S. Mainland, all baggage will, at that time, be inspected for prohibited plant material by a U.S. Department of Agriculture Inspector. You will also be asked to identify yourself to a U.S. Immigration Inspector.

If you have any questions, please consult our Traffic Representatives. They will be glad to assist you. Our Traffic office in Honolulu is located in the Dillingham Building, corner of Bishop and Queen Streets. Telephone 86421.



February 25

Mr. Smoot calls for me in the morning and takes me to breakfast and we have a pleasant drive in the city. First we go out to large dairy farms near the edge of the city, where I try to get some pictures. The feeding is essentially all "dry lot" feeding. They raise elephant grass that is cut green and chopped fine for the cows. Millions of acres in the tropics could be so used, if the grass were manured and fertilized a bit.

We drive into the Manoa district of Honolulu and I get some pictures of the gardens.

About 11:00 he takes me to the headquarters of the Hawaiian Sugar Planters Association where I give a talk to the agricultural staffs of the HSPA, Pineapple Research Institute, and the University, on soils in New Zealand and Australia, a little about the Pacific Science Congress, and some aspects of the world food problem. This is followed by a good question period on the last subject.

We have an excellent lunch with Bayer, Auchter, Lemmox, and others.

After lunch, I go over some of the research of the HSPA with Dr. Bayer and we discuss some of the tropical soil problems, including the black self-mulching clays, the nitrogen



K-1747 February 25, 1949
Hawaii. Near Honolulu. Cutting elephant grass for
dry-lot feeding of dairy cows.

problems, crop rotations, and so on. Then I go to the hotel, where I buy a few odds and ends, phone and get ready to meet Dr. Anderson at 5:00 p.m. He comes, and we go to the airport about 5:45. I check in and we then wait for plane leaves for San Francisco around 6:00. After a good dinner, I read until 10:00. I try to sleep but with some difficulty.



K-1750 February 25, 1949
Hawaii. Near Honolulu. Banyan tree.

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plane down. The wheels are on the runway at 8:10 a.m. By a thin chain of the teeth I get from Pan-American to TWA for the flight for Chicago. It begins to rain as I get in the plane about 9:00. Almost immediately we are in heavy clouds. It is clear a bit over Nevada, Utah, and Wyoming, but the rest is solid clouds. What a tedious ride! I am so terribly sleepy I just can't sleep. It clears just at dusk, as we come close to Chicago. There is only a little snow, but much ice. The land looks very cold. We are down in Chicago at 6:05, and I transfer immediately to the plane for Washington and am in the air at 6:20. What a tedious day!

We are down at Dayton, Ohio, at 9:15 for a brief stop. I rush into the airport and send a message home. Then when I am back in the plane, it is decided that this plane is not quite safe. We wait and wait.

Finally we are transferred to another plane and wait some more.

February 26

About 5:00 a.m. I shave and have a very light breakfast. I read for a while as the dawn comes. It seems now that we may come in a bit early. I hope so, for then I can get away at once. It will be very close.

It is cloudy as we come into San Francisco. Somehow the pilot miscalculates and does a lot of circling before he can get the plane down. The wheels are on the runway at 8:10 a.m. By a thin "skin of the teeth" I get from Pan-American to TWA for the flight for Chicago. It begins to rain as I get in the plane about 9:00. Almost immediately we are in heavy clouds. It is clear a bit over Nevada, Utah, and Wyoming, but the rest is solid clouds. What a tedious ride! I am so terribly sleepy I just can't sleep. It clears just at dusk, as we come close to Chicago. There is only a little snow, but much ice. The land looks very cold. We are down in Chicago at 6:05, and I transfer immediately to the plane for Washington and am in the air at 6:20. What a tedious day!

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some more.

We are in the air again at 9:50, one hour late; then down in Columbus at 10:20; and in the air at 10:45.

This trip from Columbus, Ohio, to Washington seems to me to be the longest I have ever had. (I know that Yakutsk to Fairbanks was worse, but that was so long ago!)

Thus does another day end.

February 27

Finally down in Washington airport at 12:50 a.m., and very glad indeed I am.

Comments made by Dr. L. I. Grange

- 1* (page 9). The Australian dust fell over the whole of North Auckland. The $13\frac{1}{2}$ lb. per acre was collected near Whangarei.
- 2* (page 11). We need to know the actual Maori legend to get true meaning. Basic meaning of Tara Tara is spike, spire, etc.
- 3* (page 15). The first flour mill in New Zealand was at Waimate North, but the footnote should apply to Maori farming in the Waikato.
- 4* (page 20). The chief difficulty with yellow brown earths is the establishment of clover. Soil needs to be rolled or tramped with sheep to get consolidation of fine cloddy surface. Later pugging is a minor trouble.
- 5* (page 22). All yellow brown earths of North Auckland are strongly weathered. The Marua soil is moderately leached.
- 6* (page 32). Who is Entrican? Entrican, Director of Forestry, N.Z., is a N.Z.'er. I suppose you don't mean him. (Yes - CEK.)
- 7* (page 63). Does not apply to this particular area. It is in initial stages of investigation.
- 8* (page 70). Section somewhat idealistic.
- 9* (page 72). This took place in 1886.
- 10* (page 83). Instead of "no frosts at Hastings" put, say, "long frost-free periods."
- 11* (page 119). There was a belt of beech on the slopes of the mountains, but did not extend to their summits.

